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SURF-BATHING INDOORS.—[See page 74.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Senate Bill for Safe Ships

THE bill introduced in the Senate by Senator William Alden Smith, who conducted the "Titanic" inquiry, commends itself to the serious consideration of the owners and builders of ocean-going steamships and the general traveling public.

It was inevitable that several bills relating to the subject would be introduced in Congress. Some of these call for measures which are impracticable; but the bill of Senator Smith shows that, whatever criticisms may have been made of his methods of conducting the "Titanic" inquiry, he has very clearly learned the lessons of the great disaster, both as to the causes which led to it and the remedial measures which must be taken to prevent its possible recurrence.

The SCIENTIFIC AMERICAN has claimed from the very first that the most important lesson taught by the disaster was, that present methods of constructing large ocean-going steamships do not make adequate provision to protect their flotation in the event of collision. So far as her strength was concerned, the "Titanic" was a most excellently constructed ship. The great defect in this vessel, and in at least 95 per cent of the merchant ships afloat to-day, is that the provisions against sinking, such as bulkheads, water-tight decks and the double skin, are altogether too few, and such as exist are insufficiently worked out.

Therefore, we are glad to note that the Smith bill calls for the inclusion in ocean and coastwise steam vessels of certain safety elements, designed to protect the flotation, which, as we have shown in these columns, would have saved the "Titanic" had they been present within the structure of that ship. If the bill becomes law, it will be necessary for every steel ocean or coastwise sea-going steam vessel and every steel steam vessel navigating the Great Lakes carrying one hundred or more passengers, to have a water-tight skin inboard of the outside plating. This skin must extend not less than 10 per cent of the load draft above the full load water line, either as an extension of the inner bottom plating or in the form of longitudinal water-tight bulkheads, and it must reach from the forward collision bulkhead over not less than two thirds of the length of the vessel.

The transverse bulkheads are to be so spaced that any two adjacent compartments of the vessel may be flooded without destroying its floatability or stability. We could wish that the bill read "any three adjacent compartments;" for it is certainly conceivable that collision with another ship or a long tearing wound, such as that received by the "Titanic," whether through the side plating or through the double bottom, might fill at least three compartments.

The transverse bulkheads forward and abaft of the machinery spaces are to be continued water-tight vertically to the uppermost continuous structural deck; and this deck is to be fitted water-tight. Bulkheads within the limits of the machinery spaces must extend not less than 25 per cent of the draft of the vessel above the load water line and they must end at a water-tight deck.

Applying the foregoing regulations to the "Titanic," it would mean that the first four and the last three bulkheads would be carried up to the shelter deck about 30 feet above the water line; and the bulkheads throughout the engine and the boiler room spaces would be carried to the upper deck to a height of about 10 feet above the water level.

Finally, all water-tight bulkheads and decks must be proportioned to withstand, without material permanent deflection, a water pressure equal to five feet more than the full height of the bulkhead. Bulkheads of novel dimensions or scantling are to be tested by actual water pressure. The bill would be improved if this read that all bulkheads before being passed by the surveyors should be tested by actual water pressure.

The bill, as we have said, makes excellent provision for safeguarding the flotation of future ships. We suggest, however, that it would be much improved if a clause were added stating that all openings leading from the boiler and engine rooms and the holds to the shelter deck must be inclosed in steel water-tight trunks, or casings. This provision should be so worded as to apply to openings for boiler uptakes, ventilating shafts, ladders and cargo hatches. The provision of such casings would prevent water, which might enter the ship below the water line, from rising above the water-tight deck and flooding the decks above.

The Royal Society

ALMOST every eminent Englishman seems at some time to have tossed into a hat a handful or so of that form of carbohydrate food used in the making of "alphabet soup:" to have taken out at random, just as from a church fair "grab bag," a number of these letters and have suffixed them in a long string to his natal and baptismal cognomina. Among these seemingly adventitious combinations the most highly prized by Englishmen of science is that denoting fellowship in the Royal Society of London for Improving Natural Knowledge. This superb institution—when time presses called simply the Royal Society—on the 15th of July celebrated its 250th anniversary. It was founded by Charles II, of otherwise rather nebulous memory; and all his male successors on the British throne have been members, including the present King, who evinces a very active interest in its welfare and in its beneficent deliberations.

Representatives of the French Academy, which Cardinal Richelieu founded only a few years before the Royal Society, attended the anniversary celebration. The Society seems to have been originated, not by an Englishman, but by a German—Theodore Haak, who came from the Rhine Palatinate and instituted in 1645 weekly meetings "of divers worthy persons inquisitive in natural philosophy and other parts of human learning, and particularly of what has been called the new philosophy, or experimental philosophy;" and another German, Heinrich Oldenberg, was the first secretary. Three years later a sister organization, the Philosophical Society of Oxford, was founded in that university. A most friendly intercourse was maintained until, in 1660, under the chairmanship of Dr. Wilkins, their activities were joined in a metropolitan corporation for promoting "physico-mathematical, experimental learning and philosophy." Sir Robert Moray was the first president; and among others have been Newton and Lister. Several great Americans have been or are fellows—Benjamin Franklin, Benjamin Thompson (Count Rumford), Alexander Agassiz, Simon Newcomb, Dr. S. Weir Mitchell.

The membership has from the beginning been limited to fifty-five; most of these famous men have ever been and are advanced in years on joining the Society, such fellowship meaning to them the crowning point of a career devoted to science. And there are fifty honorary foreign members, without power and selected by the council from among men eminent in science abroad. The annual election of officers is held on the day of the Society's spiritual patron, St. Andrew. It receives from the British Government an annual grant of £5,000. A report on its considerable trust funds and its other sources of revenue is published annually. Its expenditures are for the public weal; every year thousands of pounds are devoted to the promotion of scientific research, and to paying for the experimental work of scientists who personally lack the means. Through its long and most honorable existence, it has ever been the principal advisor of the State and Crown in all matters of science. It is officially represented on the governing body of every kind of governmental and semi-public scientific and other educational institution. Its counsel is sought and given on matters innumerable. It keeps ever in touch with learned societies throughout the world.

It has the custody of the standard copies of the Imperial Standard yard and pound; it controls the National Physical Laboratory, which was established by the Government on its recommendation; it superintends the Kew and the Greenwich observatories; on its initiative, and by its advice, the Government inaugurated the geodetic survey in 1791. Other enterprises which have had the Society's aid are the expedition of Capt. Cook to observe the transit of Venus, and that great commander's circumnavigation of the globe; the various Arctic expeditions under Ross, Parry, Franklin, and Nares; the "Challenger" expedition; the International Congresses on the questions of a prime meridian, and of an international seismological investigation system; tidal observations; protection of buildings from lightning; tropical diseases; color-blindness; and much else impossible of enumeration.

The Conquest of Disease

THE Health Department of this city is to be congratulated upon the statistics showing the death rate in New York from natural causes during the forty-six years covering the period since the department was organized. In the year 1866 the death rate ratio was 36.31 per each thousand of population. To-day the ratio is 15.13 per thousand.

Well may the report say "The facts are significant. They show in an unmistakable manner the success of public sanitary administration which has directed its efforts almost entirely against infectious diseases."

Peace hath its victories—and surely this successful conquest of disease is one of the greatest of them. Our satisfaction in contemplating a reduction of over 50 per cent in the death rate of New York, our admiration for those thoughtful, highly intelligent and always industrious men who, in the quiet of the laboratory, have been carrying on the fight against disease, becomes the greater when we remember that what has been done in this city has been done also in a hundred others.

A reduction of over 50 per cent in less than fifty years in the death rate justifies, surely, the hope that before another fifty years has passed science will have obtained a complete mastery of infectious diseases, and mankind, once the prey of superstition and a predisposing dread, will have realized that, if certain simple salutary laws are followed, it can live its day-by-day life free from all fear, even of the great white plague itself.

Certain diseases there are which to-day remain unconquered, chief among which is the last-named. Yet even these are gradually being brought under control, and the progress in bacteriology, particularly during the past decade, has been such that, even in the laboratories (where predictions are never made) one can detect a note of strong hopefulness that consumption and the few other of the diseases which have hitherto stubbornly withheld their secrets, will be brought within absolute control.

It is an amazing fact that the very methods by which the bacteriologist has achieved his wonderful success are being bitterly attacked. Had it not been for the practice of vivisection, this 50 per cent reduction in the death rate could never have been accomplished. So far from the bacteriological investigations which have been made in the laboratories of this and other cities being marked by needless cruelty, the discomfort or pain which may have been suffered by a certain few dumb animals has brought untold benefit and relief.

The Exiles of the South Orkneys

THE heroism of the cosmopolitan group of scientific men that keeps in operation the Argentine meteorological station in the South Orkneys attracts surprisingly little attention, even from the scientific public. The station was originally established by the Scottish Antarctic Expedition of 1903-04 and was taken over in 1904 by the Argentine Meteorological Office. Every year a party of four—three observers and a cook—is sent out from Buenos Aires to spend a year of exile in this inhospitable spot, which, although north of the Antarctic circle (lat. 60 deg. 40 min.), is generally ice-bound, and has a truly polar climate. The mean annual temperature is 23.8 deg. Fahr. The snowfall is excessive, sunshine is rare, and strong gales are frequent. Moss and lichens are the only vegetation.

From a purely scientific point of view, the study of the winds and barometric pressure distribution of the Antarctic is peculiarly interesting on account of its comparative simplicity. The South Pole lies at about the center of a dome-shaped continental glacier, so that the wind-system belonging to the planetary circulation and that due to air drainage down the glacier slopes are approximately concentric.

It is urgently desirable that other fixed and permanent meteorological stations should be established in the south polar regions. Pending this consummation, the enlightened policy of the Argentine government in maintaining a station in the South Orkneys, at a cost of from $20,000 to $25,000 a year, is most commendable. Special praise, however, is due to the devoted men, of several nationalities—Scotch, American, and others—who are unobtrusively carrying out this important undertaking, with all the hardships it involves. They richly deserve the tribute paid to them by M. Rouch, of Dr. Charcot's last Antarctic expedition, in a recent address before the Société Météorologique de France:

"There, for a year, in a primitive house, amid continual storms, never sure of the return of the ship, which, in order to reach them, must sometimes penetrate a difficult ice pack, they lead the traditional existence of a polar winter sojourn; obliged to bear every drudgery and to endure a rigorous climate. They do not call themselves polar explorers, and on their return to civilization they do not go about the world delivering lectures—hence they are unknown. But is it not just that I pay this tribute of my admiration to these men?"

Engineering

New French Dreadnoughts.—The French navy is following the lead of Great Britain and the United States by increasing the caliber and reducing the number of guns in her main batteries. The three new battleships, the "Lorraine," the "Bretagne," and "Provence," of 23,500 tons, will carry ten 13.5-inch guns, all placed on the longitudinal center line of the ship.

The Largest Warship.—Although authorities differ as to the dimensions of the recently-launched British battle-cruiser "Queen Mary," there seems little reason to doubt that she is the largest warship afloat at the present time. Some authorities give her dimensions as follows: Length over all, 725 feet; beam, 87 feet; and displacement, 29,000 tons. She will probably make over 30 knots on trial, and to do this her turbines will have to develop not far short of 100,000 horse-power. The "Moltke," of 23,500 tons approximate displacement, required 90,000 horse-power to drive her at from 29 to 29½ knots.

Thirty Miles of Warships.—Great Britain has been the scene of some remarkable naval mobilizations, of which, until this summer, the most notable was that held during the coronation festivities last year. In point of size, however, that review was surpassed by the one held at Spithead last month, when 239 warships, big and little, were drawn up in six parallel lines, which, if strung out in single line, would have extended for 30 miles. The significance of this display will be appreciated when it is remembered that Great Britain is building warships at a faster rate, and is building more of them, than at any period in the history of her navy.

Scouting by Submarine Bell.—Four of our naval submarines, using the submarine bell as the only source of communication, recently went in search of the "Castine," which represented an enemy's ship. The submarines maneuvered in depths of from 20 to 60 feet, and finally the "Castine" was found and theoretically sunk by four torpedoes provided with dummy heads, which were successfully discharged at the ship. It may be mentioned that the submarine bell affords effective protection against collision, since the throb of the engines of an approaching ship can be distinctly heard when the submarine is below the water.

"Titanic" Inquiry Concluded.—The Board of Trade inquiry into the "Titanic" disaster has been concluded, and its President, Lord Mersey, has announced that its report will be produced "within a reasonable time." The Attorney-General referred to the inaction of Capt. Lord, of the "Californian," and said that he had come to the conclusion that there was no excuse to be found for his conduct on that night when, as the evidence showed, his ship might have reached the "Titanic" in time to save the whole of her passengers. He asserted that utterly unnecessary risks had been taken by the "Titanic," and that the causes of the disaster were a bad lookout and excessive speed.

A 32-knot Steam Yacht.—The turbine yacht "Winchester," built for P. W. Rouss, Esq., of New York, by Yarrow & Co., under the supervision of Cox & Stevens, naval architects, New York, ran her full speed trials recently on the Skelmorlie deep water measured mile, attaining a mean speed of 32¼ knots. This was a quarter of a knot in excess of the contract speed. The "Winchester" is 205 feet in length and 18 feet 6 inches in breadth, and the trials prove her to be one of the fastest yachts afloat. The propelling machinery consists of Parsons turbines, driving two shafts, and steam is supplied by two of the firm's water-tube boilers fired with oil fuel.

Hydraulic Transmission for Diesel Motors.—The Vulcan Company, of Stettin, are building two Föttinger transformers, capable of delivering 1,200 horse-power, for a vessel to be employed in the Congo trade. It begins to look as though the introduction of Diesel engines on ocean-going ships, particularly those engaged in freight carrying, will produce a widespread demand for an efficient speed-reduction mechanism. Three types are available—the mechanical, the electrical and the hydraulic. The mechanical leads in efficiency, the electrical in the wide range of speed control, and the hydraulic reduction gear, although lower in efficiency than the others, has the advantage of quick reversing, a wide range of speed and great reliability.

Memorial to "Titanic's" Engineers.—One of the most striking instances of devotion to duty in the "Titanic" disaster was that afforded by the engine-room staff. In a sudden emergency, such as overtook this ship, the order for the engineer staff is "all below;" and, judging from the fact that not a single member of the staff of thirty-four, including John Bell, the Chief Engineer, survived the disaster, it is believed that every one of these men remained at his post to the very last and went down with the ship. Engineers the world over are invited to contribute to a Shilling Fund (25 cents) to erect a suitable memorial in Southampton. Contributions will be received in the United States by Mr. H. L. Aldrich, *International Marine Engineering*, 17 Battery Place, New York city.

Aeronautics

Newest Record for Speed.—Vedrines traveled for two hours at a speed of one hundred and six miles an hour at Rheims, on July 13th. He broke all records.

The Wright Hydro-aeroplane School.—Orville Wright has decided to open a station at Glen Head, L. I., where the use of the hydro-aeroplane is to be taught. The station will be in operation, it is said, on or before August 1st.

The Aeronautic War Fund of France.—According to *Le Temps* the National Committee for Military Aviation has collected the sum of 1,280,373 francs for aviation purposes. The National Committee has already turned over to the Ministry of War the sum of 500,000 francs for the purchase of thirty-three aeroplanes.

A Hydro-aero Bus.—Roger Sommer has built a hydro-aeroplane which is to carry six passengers. The machine is to be used on Lake Geneva. Tickets will be sold to tourists. The maximum speed is to be only forty-five miles an hour. Daily circuits are to be made from town to town around the lake.

Japan Buys Aeroplanes in America.—It has been announced at the office of Glenn H. Curtiss that the Imperial Japanese Navy has placed an order for three hydro-aeroplanes, and that three Japanese Navy officers are now on their way to Hammondsport, where they will be taught to fly the machines.

A Glenn Curtiss Launching Machine.—Glenn Curtiss, the well-known aviator, has secured a patent (No. 1,027,242) for a means for launching flying machines, which comprises a suitable mount with an aeroplane supporting device pivoted upon it, in connection with which he provides means for imparting at a variable speed an angular throw to the supporting device so that the machine is brought to a position after it has attained a maximum velocity which position is according to the proposed direction of flight.

Aeroplane Fleets for Argentina and Roumania.—The recent popular movement in Italy whereby the army of that country became possessed of a fine fleet of aeroplanes has had parallels in Argentina and Roumania. It is reported that the Sociedad Sportiva Argentina has offered the Minister of War an aerial fleet, the cost of which will be defrayed by the sale to the public of 1,500,000 illustrated postcards. A competition was recently held to obtain suitable designs for the cards, viz., allegorical representations of the military uses of aviation. An Aerial League has been formed in Bucharest for the purpose of raising funds by popular subscription with which to buy aeroplanes for the Roumanian army.

Do Flying-fish Fly?—This much-mooted question is discussed by William Allingham in the *Nautical Magazine*. The orthodox scientific opinion is that the "wings" of the flying-fish merely serve as a parachute to sustain the fish for a brief period in the air, after he has launched himself out of the water by a powerful screw-like movement of his tail. According to this view, the fish has no power of directing his flight after he has left the water. However, Mr. Allingham, who is a nautical expert attached to the British Meteorological Office and is in constant intercourse with seamen, reports many observations that tend to controvert this opinion. Certain observers claim that the wing-fins are in constant rapid vibration, and seem actually to serve the purpose of flight. One vessel master watched a fish that had attained an altitude of 20 feet above the water, and was flying toward the mizzen rigging of his ship when, apparently noticing the obstruction, it changed its course about 60 degrees, crossing the vessel's stern to regain the water. Many other similar observations are mentioned. A series of cinematograph pictures might solve this question once and for all.

Death of Hubert Latham.—Hubert Latham, one of the pioneer aviators, was killed by a buffalo on June 7th in a hunt in the French Soudan. He was one of the few men who first took up aviation and who was still flying almost up to the time of his death. The rest have either been killed or have gone into the safer vocation of manufacturing. Latham took up flying very soon after Wilbur Wright made his demonstrations in France. He always flew an Antoinette monoplane. He had not been flying many months before he decided to cross the Channel. His first attempt was made on July 19th, 1909. He flew half-way across and then fell into the sea and was picked up by a French torpedo boat. After Blériot had performed the feat, Latham made a second attempt on July 27th, covering nineteen of the twenty-two miles. Just off Dover he again fell into the Channel. Latham was phenomenally lucky. He emerged time and time again from accidents without serious personal injury, although he smashed machine after machine. In his day he was a record breaker. He held records for endurance, height and speed, all of which, however, have since been broken. Americans will remember him as one of the contestants on the French team that competed at Belmont Park in 1910.

Automobiles

When Kerosene is Useful.—A motorist from Marion, N. Y., the other day was caught miles away from a garage, without a drop of gasoline on which to get home. Inquiry at farm houses nearby failed to reveal any available supply of the "precious fluid," and so he decided to try a can of kerosene. As the motor was still warm, he had no difficulty at all in starting it and finishing his run home without further trouble.

Folding Chairs of Pressed Steel.—Folding chairs made of pressed steel, which can be folded together so as to look like an ordinary music holder, and slipped into a cover, are the latest in the accessory business. Although the weight of the chair is but thirty ounces, it is built strong enough to support a man weighing four hundred pounds.

Nickel Trimmings Now Popular.—A large proportion of the 1913 output of the American automobile companies will have nickel trimmings. The beauty and durability of nickel, and the ease with which it is kept bright, commend its more general use. At any rate, it is a tasteful compromise between the brilliance of burnished brass and dull effects of the more utilitarian finishes, such as gun metal.

Subsidizing Motor Cars.—The British War Office has drawn up a provisional scheme for subsidizing "petrol motor lorries" (i. e., gasoline trucks built for carrying heavy loads) built after January 1st, 1910, and owned by civilians. The owners are to receive an initial subsidy varying from $39 to $58, and an annual subsidy of $73, in return for which they are to agree to turn over their wagons to the government in case of war, at a fixed price.

Reinforced Bulb Horns.—Because the ordinary bulbs used on automobile horns have invariably been a source of trouble and annoyance to the motorist, and because the various mechanical horns are making such a remarkable progress, a French horn maker has brought out a reinforced bulb for the ordinary reed horn, which has several unusual features. Instead of being smooth and slippery, the new bulb is ribbed horizontally and vertically, affording a good grip to the fingers and strengthening it to such an extent that it will outlast three ordinary bulbs.

Race Victories and Sales.—The public, of course, well knows that race victories influence to a certain extent the sales of cars, particularly of those of the "roadster" type. But it must come as a distinct surprise to hear of a German factory which by good judgment and good luck managed to win three successive road races and one reliability tour, whereupon it received a cable order from England for no less than eight hundred chassis of the winning type. Previous to the winning of these races the entire output of the factory amounted to only one thousand cars.

Dual Wheels for Heavy Cars.—Instead of mounting dual rubber tires on a wide-rimmed wheel, for use on heavy-duty trucks, a New York tire expert has invented a dual wheel, which is said to have shown great efficiency in the trying-out process. The wheels are staggered, one spindle being in front of and the other behind the line of the axle. The spindles are connected by means of an equalizing bar, which permits the wheels to follow the contour of the road and equally divides the load between them. While the wheel is to be made in New York by a well-known rim manufacturer, it is based on patents which were granted to Molesworth, the British scientist. The invention was improved and developed by Alexander Dow.

Emergency Steering Device.—Many of the most serious accidents in fast driving, and especially in racing, arise from the breaking of the steering knuckle and the subsequent swerving of the front wheels. A Rochester mechanic has patented a device which is designed to prevent the swerving of the wheels in the event of a fracture of the steering gear. The device is practically a double steering gear, operating independently. The main gear is attached to the machine and the second gear can be put on if desired. The former operates on a knuckle joint, while the latter acts directly on the wheels. A steering post is fastened directly beneath the steering wheel, and operates on a worm screw connected with rods on which are bolted collars set in a flange bolted to the wheels. The flanges are constructed so the collar rests in them and runs on ball bearings, the two wheels being connected by rods across the front of the machine, in addition to the usual tie rods. If the main gear breaks, the rods hold the wheels from swerving and steer as if nothing had happened. If one of the rods of the device breaks, the other will do the work. If a nut comes off one of the wheels, the flanges and collars will tend to prevent the whole from coming off, and even if the axle should break, the device will do its share toward preventing a bad smash-up; the machine will rest on the rods and give the driver a chance to come to a stop without turning a somersault.

Fig. 1.—A Central American Indian woman, a white boy and a negro photographed with ordinary light.

Fig. 2.—The same subjects photographed with invisible ultra-violet light.

Fig. 3.—This photograph was made with infra-red light.

Black and White Men in Invisible Light

Tricks Played by Ultra-Violet Rays

By Gustave Michaud and Fidel Tristan, Costa Rica State College

SEVERAL hypotheses have been advanced to explain the difference in color between the southern and northern races of mankind. None is entirely satisfactory. It occurred to the writers that some progress might perhaps be made toward the solution of the problem if the relative absorption of light by the white and colored skins was considered not only for the visible radiations, but also for the invisible yet ever-present ultra-violet and infra-red lights.

A group composed of a dark-skinned negro, an Indian woman of a chocolate color with perhaps an admixture of negro blood, and a white boy of Alpine descent was photographed successively in visible light, in infra-red and ultra-violet lights. Foucault's filter (3,160 to 3,260) was used for the ultra-violet, the objective being a quartz lens silvered on both sides. Exposure in full sunlight: 3 minutes. For the infra-red, Prof. Wood's filter was slightly modified; the 15-gramme gelatin filter made by Messrs. Wratten and Wainright, of Croydon, England, was placed between two disks of cobalt glass of the darkest shade used by oculists. The spectrum panchromatic plates, sensitive to the infra-red, and made by the above named firm, gave a tolerably good image with an exposure of 7 minutes.

The result was of a somewhat unexpected and confusing nature and is clearly told by the accompanying three photographs. The difference in the absorbing power of the black and white skins decreases from the infra-red to the ultra-violet. In the infra-red it is by far greater than in visible light. In the ultra-violet it is almost *nil*. Indeed, it may be said that, if our eyes were sensitive to ultra-violet light only, all men would be negroes, so far as color is concerned.

Some years ago, one of the writers (SCIENTIFIC AMERICAN, November 5th, 1904) ventured to explain the genesis of the white races of men through a process similar to that which bleached the fur of most northern animals which hunt or are hunted. During the whole Paleolithic and great part of the Neolithic ages, man was ignorant of agriculture. In Abbeville, in Spy, in Mentone, in Hoxne, in the caves of Périgord, numberless flint or bone implements were found which prove that fact. The Paleolithic man was a hunter, and this being recognized, it becomes easier to explain how his color was changed, like that of other northward-migrating carnivora, than to explain the reason why he should have been an exception to the general rule. Primitive tribes were probably often decimated by hunger, as the Canadian Indians of to-day. Those hunters who exhibited on the snow a sallow face, black hair, beard and eyes worked at a disadvantage when compared with somewhat lighter-complexioned comrades. They were more conspicuous on the white field, and could not so easily approach their prey within striking distance. When food was scarce, mortality was the greatest in their families; the lighter-complexioned individuals leaving in every generation the larger posterity. If that explanation holds good, it is rather easy to understand the reason why the selective process which decreased the absorption of visible light by the skin had no such influence on the invisible ultra-violet light. Why and how the same process should have deprived the white skin of the power of absorbing the warm and invisible infra-red radiations is by far more difficult to understand. It seems that such radiations are needed above all by the man who must withstand the effects of a cold climate. Yet the negro is the man whose skin is so organized that it can absorb them.

"Heart Stopping" as a Profession

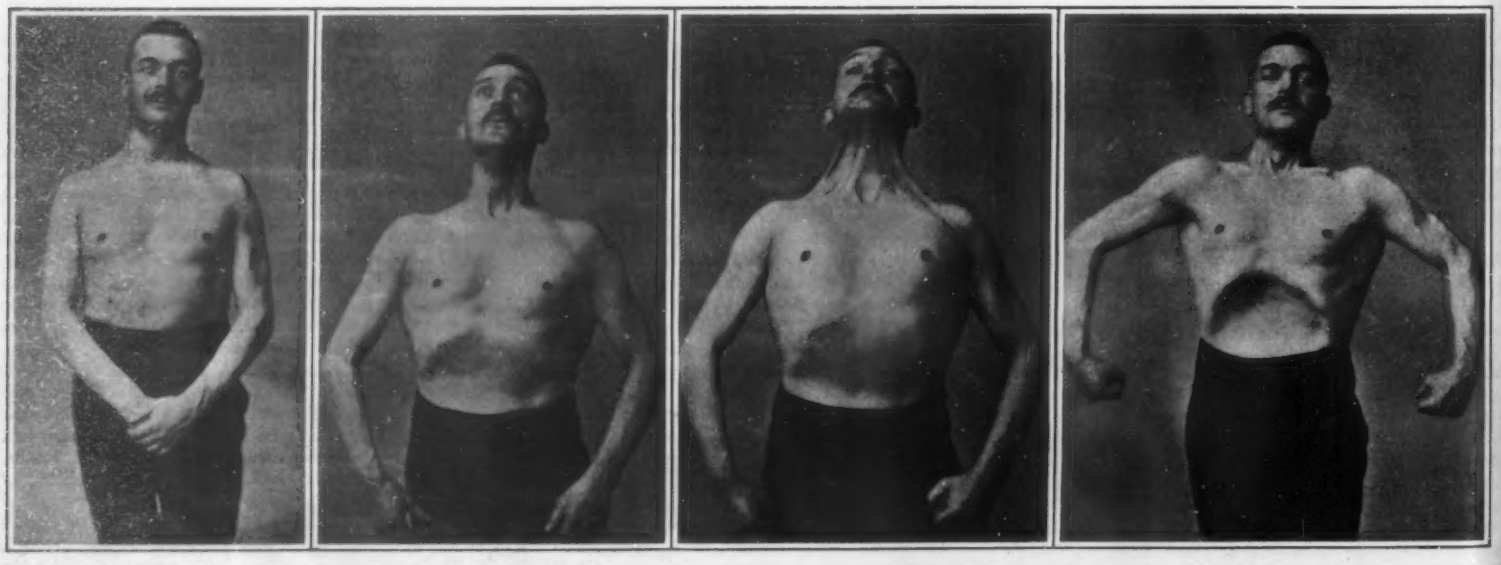
Examples of Muscular Control of Scientific Interest

By John B. Huber, A.M., M.D.

A MAN recently exhibited himself in London, who, according to an imaginative press-agent, gave "an extraordinary demonstration of phenomenal muscle manipulation and stopping the beating of the heart," before members of the medical profession in London. I cannot find, however, any report of this demonstration. The press agent states that "by years of hard work, careful study and immense concentration of mind," the athlete in question "can manipulate his muscles to an extent never before deemed possible in medical history." Many men have by exercises developed enormous muscles, but they have been invisible and remained firm to the touch even when relaxed. But this athlete can relax his muscles to such an extent that "by shaking his arm he can make the triceps quiver like reeds shaken by the wind." More than this, he can stop the beating of his heart for more than twenty seconds, and retard or accelerate his pulse at will, thereby defying the laws of nature. There is no authentic case of this feat ever having been accomplished before. In the second of the photographs here published the flesh has been drawn tightly into the throat and up under the under jaws, by muscular contraction, "all being as solid as a block of marble." In another the muscles of the neck are made distinct. Still another shows unusual manipulation of the abdomen. The athlete "can draw in his stomach to an extraordinary degree and also protrude it as much in the opposite direction."

It is also claimed that this performer can remain under water from six to eight minutes, and that he can live for a protracted time when buried in the ground.

(Continued on page 85.)



1.—The athlete's body in repose.

2.—The flesh drawn tightly into the throat by muscular contraction.

3.—Appearance of a curtain produced by muscular control.

4.—The abdominal muscles contracted to cause concavity.

The "Commonwealth"-"New Hampshire" Collision

The Bulkhead and the Watertight Deck Prove Their Value

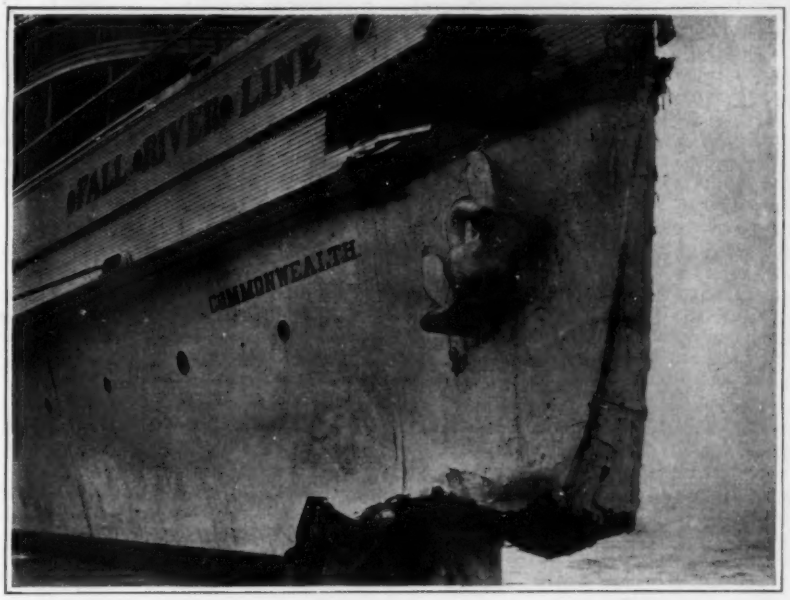
IT would be difficult to find a better example of theory borne out by actual practice than occurred in the recent accident to the U. S. S. "New Hampshire" when run into by the Fall River Line steamer "Commonwealth."

The accident occurred in Newport harbor about 5 A. M. on the morning of July 7th. The battleship "New Hampshire," displacement 16,000 tons, was lying at anchor in a heavy fog, when the "Commonwealth," one of the most palatial of modern steamers, with a displacement of about 4,500 tons, rammed the stern of the battleship at a point about six feet to starboard of the center line. Chance could hardly have chosen a better point for the collision to occur, for, in spite of the fact that the "New Hampshire's" full crew was about 750 men and the "Commonwealth" was probably carrying an equal number of people, not a single fatality or injury of any kind resulted.

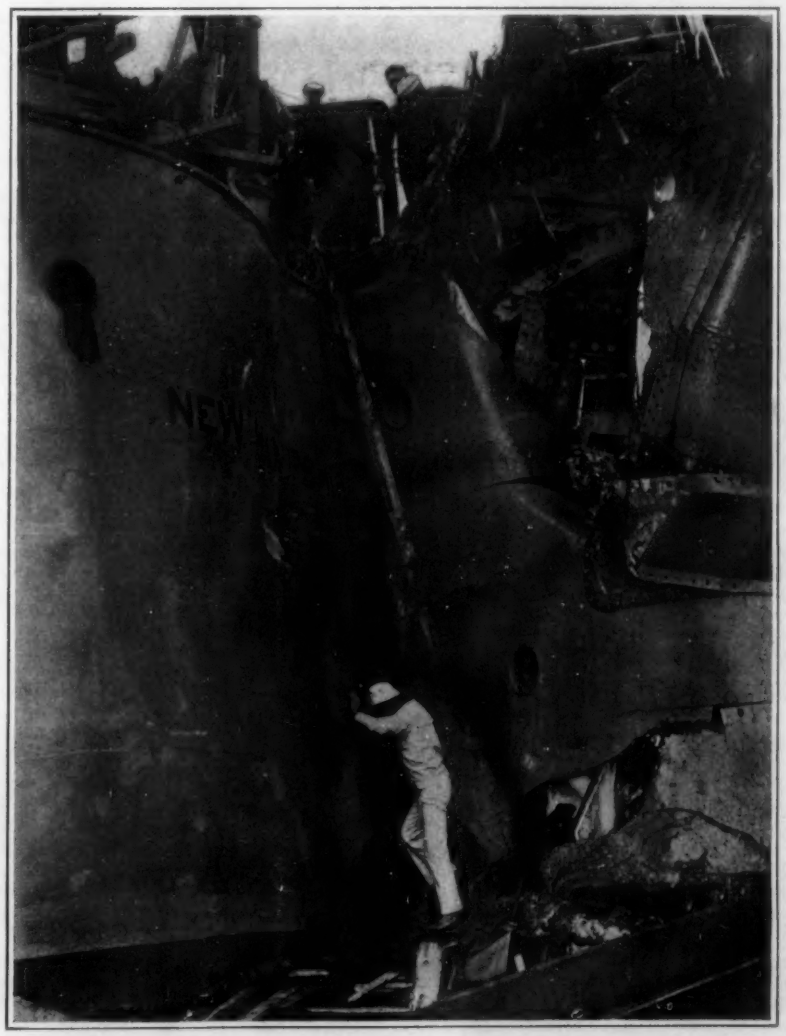
The general extent of the damage to each vessel can be observed roughly by referring to the two photographs, and it will be seen that as usual the body receiving the blow has suffered considerably more damage than the body inflicting the blow. At first sight, it would seem that Newton's law of motion, "Action and reaction are equal and opposite in direction," is not evidenced here. Just here though the point is frequently overlooked, that in addition to the structural damage to the "Commonwealth," *the speed of her great mass was reduced almost immediately to zero*, and it is this consideration that brings the theory and practice in accord. Some idea of the force of such a blow can be approximated from the following calculation. In the absence of any definite information on the subject, assuming a speed of 15 feet per second (corresponding to slightly over eight knots per hour, which is considerably less than half speed for the "Commonwealth"), and a displacement of 4,500 tons, we find that the energy of the blow which she delivered against the "New Hampshire" was about 16,000 foot-tons. This would be sufficient to lift the battleship one foot into the air.

In considering the relative effects of such a collision on the two vessels it is to be remembered that the "New Hampshire" received the blow practically *broadside on*, so that her plating acted merely as a thin membrane for holding together the framing, and except in assisting to transmit the stress to the framing the plating itself could not be expected to contribute any material resistance to the blow. The "Commonwealth," on the contrary, delivered the blow with her knife-like bow armored with its steel stem, and her plating received the impact *edge on*, so to speak, and in the most advantageous way possible to enable the plating not only to transmit the stress to the framing, but also to take its full proportion of such stress.

An examination of the stern of the "New Hampshire" by our representative disclosed the fact that she had withstood the enormous impact remarkably well. One could not desire a better tribute either to the quality of the product of our steel manufacturers or to the careful and efficient inspection of every piece of material entering into the hull of such a vessel by the representatives of the Navy Department, than was given by a view of the tangled and distorted mass of twisted plating and shapes.



Bow of the "Commonwealth," showing how the steel protective deck of the battleship cut deeply into the bow structure.



The protective deck of the "New Hampshire," upon which the seaman is standing, is intact. The lighter structure above was torn loose and driven into the ship.

The outside shell plating, ⅝ inch in thickness, from main deck to water line was bent inboard in a wedge-shaped section corresponding somewhat with the shape of the "Commonwealth's" bow. The point of impact at the rail of the main deck had been bodily carried forward a distance of over twenty feet, and, as can be seen from the photograph, shows no sign of cracking or rupture throughout the twenty feet of height between the protective and main deck. The rivets, too, have apparently held well, showing surprisingly few heads snapped off. At the protective deck, 1½ inches thick, which on this vessel comes slightly below her water line, the plating and frames have been sheared off, leaving the flat top of the heavy watertight protective deck intact, and as good as the day it was originally installed. There was apparently no damage whatever below the protective deck, which is only another excellent example of the great advantages to be gained either in warship or merchant construction of a heavy watertight deck at or near the water line. The presence of this deck slightly below the water line and its absolute intactness prevented practically any water at all from entering the ship.

The plating of the gun and berth decks has been considerably buckled and torn, and the four or five after beams and frames on both sides were so badly twisted as to require renewal. On the main deck the plating and beams were badly beat, and the wood deck torn and shattered.

The compartments involved were the extreme after cabin of the commanding officer, the bath and shower room for the wardroom officers, and the after staterooms on each side. In these spaces all fresh and salt water piping, ventilation ducts, steam pipes, electric light fixtures, wiring and conduit, tiling, etc., were completely wrecked, together with a number of fittings, such as airports, gunport shutters, deck stanchions, flagstaff, etc.

Several of the 2-inch nickel-steel plates of armor protecting the after 6-pounder guns were bent through an angle of about 125 degrees, but gave no evidence of cracking, and the authorities expressed the belief that these could be heated, straightened and used again. One heavier 3-inch plate of armor at the water line showed evidence of having been slightly bent in on one corner, but no further injury was received by the water-line armor.

There was apparently no damage done to the propellers, shafting or rudder, which can only be considered a piece of very good fortune.

The repairs to the stern, which must be done with the vessel in dock, will probably be executed by cutting off the whole damaged portion above the protective deck by the use of pneumatic chipping hammers, and the oxy-acetylene flame, and lifting it bodily off. This portion will then be replaced by a whole new stern, fitted complete in all respects, which will require an expenditure of about $15,000 and six weeks time.

The damage to the "Commonwealth," which it is also estimated will cost about $15,000 to repair, consisted of a broken stem and a very badly crumpled and twisted bow, which will involve the renewal of a large number of her forward plates and frames, and will necessitate docking the vessel. The injury sustained by this vessel shows the great value of efficient collision bulkheads, which held perfectly in this case. The knife-like effect of the armored protective deck of the battleship in shearing the shell plating and forward frames of the "Commonwealth" is plainly visible in the illustration.

The most gratifying thing about the accident, if indeed anything can be said to be gratifying about such an unfortunate occurrence, was the perfect order and discipline observed on both vessels immediately after the collision. In spite of the heavy fog that prevailed, and the fact that, except for those immediately on

(Concluded on page 87.)

Artificial Surf Baths

A Miniature Indoor Ocean

PROBABLY no feature of the International Hygiene Exposition held in Dresden last year attracted more general interest than the Undosa artificial surf bath. The receipts from the sale of bath tickets, and especially of spectators' tickets, were unexpectedly large, amounting sometimes to $450 in a single day. As the cost of operation was only about $40 per day, it is evident that the artificial surf bath may be made a very profitable as well as a very beneficial institution.

The idea of generating waves in still water by alternately submerging and withdrawing solid bodies of appropriate form and dimension, originated with Hofrat Hoeglaner of Munich, who in 1903 obtained a German patent for a wave-producing apparatus, which was subsequently patented in the United States and many other countries. The first experiment in the production of an artificial surf bath by this method was made in 1905 in a concrete basin built in Lake Stamberg.

The bath could be used only in summer, and, although it was very well patronized on clear hot days, it was evident that long periods of fine summer weather would be required in order to pay the operating expenses and provide for amortization and fair interest on the initial outlay.

It was left for the Dresden Hygienic Exposition to demonstrate that artificial surf baths can be made profitable by constructing them in such a manner that they can be used throughout the year in all sorts of weather. The directors of the Exposition had decided that the department of sport would not be complete without a large swimming bath in which swimming races could be conducted. The constructor of the bath, Herr Recknagel, suggested that it be provided with a removable roof, and also with apparatus for producing artificial surf. This plan was finally adopted after much discussion and with grave financial misgivings, and the result surpassed all expectations. During the five months of its operation the bath was visited by nearly half a million persons and earned about $30,000, which more than covered the cost of construction ($20,000), and the operating expenses (about $7,000). The cost of construction was diminished about one-half by the gratuitous contribution of many parts of the equipment by exhibitors, and the site cost nothing, but it appears probable that a similar enterprise would pay very well in normal conditions. The additional outlay for the wave-producing apparatus would not exceed $7,000.

The mechanical device by which the waves are produced is very simple in principle. It consists essentially of one or more hollow wedge-shaped bodies made of sheet iron, which are rhythmically immersed in and drawn out of the water by appropriate machinery. In situations in which the vertical elevation and depression of the wedges present difficulties the waves may be generated by oscillating vanes, but the operation is always so conducted that the water which rushes in to fill the void produced by the elevation of the wedge or the retraction of the vane passes the point of equilibrium and is heaped up by the return swing of the vane or the immersion of the wedge. The wave-forming action, therefore, is identical in principle with that of a stone thrown into a pond. If the stone falls close to the bank, so that the water can escape in only one direction, the height of the resultant waves is increased.

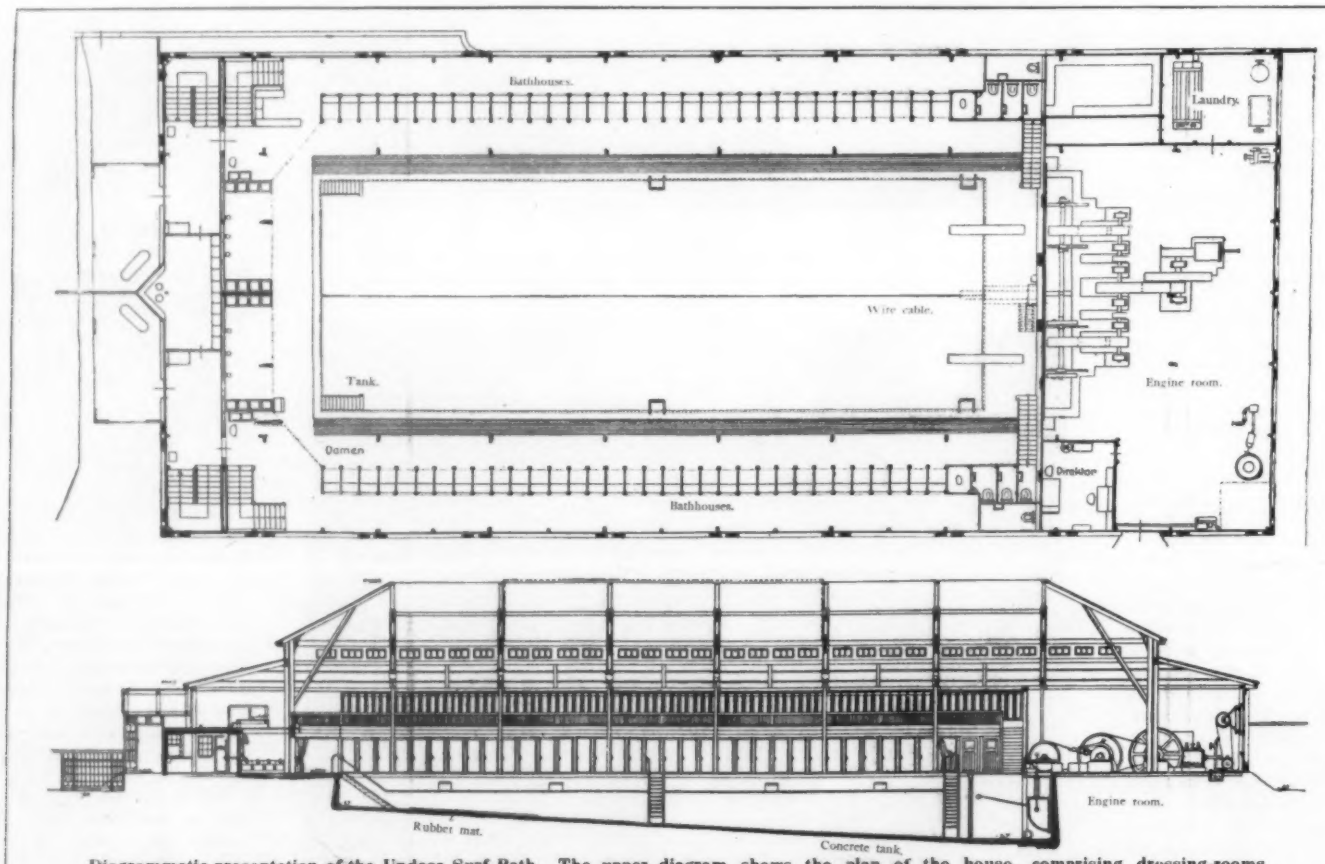
In the experimental plant in Lake Stamberg the waves were generated by three immersion wedges arranged in a straight line, each of which was driven by a separate electric motor, in order to save space. Each motor was coupled directly to a flywheel. When the motor, running without load, had attained the proper speed of rotation, the motor shaft was connected by a worm drive with a horizontal shaft carrying a crank from the end of which the wedge-shaped plunger was suspended. In designing the artificial surf bath at the Dresden Exposition steam was chosen as the motive power in order that the water of the bath and the air of the bathhouse might be heated by the exhaust steam. At first the steam was supplied by the general power house of the Exposition, about 1,000 feet distant, but subsequently a locomotive boiler of 100 horse-power was installed in the bathhouse.

The wave-generating plungers were suspended from cranks attached to a shaft extending across one end of the swimming tank, which was about 40 feet wide and 115 feet long. This shaft could be connected by belt wheels and clutches near its ends, with a countershaft at the middle of which was a wheel driven by a belt from the engine shaft. The gearing was constructed to immerse the plungers 18 times per minute when the engine was running at its normal rate of 125 revolutions per minute. The bottom of the basin was inclined in the usual manner, and the plungers were placed at its lower end, where the depth of water was about 7 feet. The waves generated at this end of the basin were more than 3 feet in height, and as they moved toward the other end and reached a point where the depth of water was less than their height they began to comb and break, and thus produced a very good imitation of the surf of a natural sea beach.

The arrangement of the plungers or vanes, and the character of the impulse impressed upon the water, can be varied in divers ways. Where space is limited, for example, a plunger could be attached directly to the piston rod of a vertical engine placed above it, as in one form of steam hammer. Plungers could be operated in the middle of a long basin so as to send waves toward both ends. The two parts of such a basin, divided by the machinery and a screen, could be used as separate baths for men and for women.

The height of the waves is conditioned by the volume of water displaced, and it can be varied within wide limits by varying either the travel of the plungers or the depth of water. For artificial basins the best practical method consists in varying the travel and distributing several plungers across the deep end of the basin. With three plungers constructed to be operated separately a great diversity of wave motion can be produced by using one plunger, two, or all three. If the three plungers, properly distributed, are operated together and synchronously, the whole basin is filled with regular waves of uniform height; while if even one plunger remains idle, the waves generated by the others spread into the calm water in front of it, and thus lose force and height as they approach the farther end. By accelerating or retarding individual plungers it is possible, as observation has shown, to produce a very complex wave pattern resembling that of the open sea.

Practically all of the conditions presented by a natural beach can be reproduced by doing away with the vertical wall at the shallow end of the basin and extending the inclined floor well beyond the water line. The difficult art of swimming in rough water can be practised at one end of the basin, while at the other end bathers can enjoy the breakers, the outrunners of which furnish safe amusement for small children. All of these persons may derive benefit from the massage effected by the moving water.



Diagrammatic presentation of the Undosa Surf Bath. The upper diagram shows the plan of the house, comprising dressing-rooms for men and women, basin, 40x115 feet, laundry, engine-room, director's office and wire rope. The lower shows a longitudinal vertical section of the same, with position of rubber mat, inclined concrete floor, engine-room and canvas roof, opened by rolling up.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The "Hawke"-"Olympic" Collision

To the Editor of the SCIENTIFIC AMERICAN:

Your article in SUPPLEMENT of February 24th, 1912, page 116, suggests that there are some things that pilots and professors do not know or have never reasoned about. For instance, that when a vessel passes swiftly through the water, and that water is deep, *the greater part of the water that refills the hole where the vessel was, comes from below.* If this was not so, almost everyone falling overboard would be struck by the propeller, which we know is not the case. Unless these conditions, it is safe for vessels in smooth water on parallel courses to range alongside one another and sheer off with ease.

Again, when a vessel passes swiftly through shallow water, she *"smells the bottom;"* that is, *the greater part of the water which refills the hole where she was, comes from the sides.* The water under the bow cannot get to the stern quick enough, so it is piled up ahead of her, as we see when large vessels are passing through the Suez canal; the ship's speed is reduced because she is trying to go stern first from the piled-up water ahead to the low-level water astern, and the rudder becomes more or less useless.

Under these conditions, practical experiment will show that safety for two vessels only lies in a *"very wide berth."*

LAW. HARGRAVE.

A Good Roads Suggestion

To the Editor of the SCIENTIFIC AMERICAN:

Regarding permanent roadways, "good roads," the writer would suggest the building of 16-foot or 20-foot Belgium pavement roads or stone block pavements, with 3 feet in depth curbing 4 or 5 inches thick. This roadway to be placed in the middle of the road, and the balance of the road could be graded or built of earth or crushed rock or of such material as found most available. This stone pavement with a 2-foot rough concrete foundation would last for many years and prove to be cheaper in the long run.

PITTSBURGER.

Pittsburg, Kan.

The Reproduction of Sound

To the Editor of the SCIENTIFIC AMERICAN:

Your Paris correspondent in a recent issue of your paper entertained your readers with the narrative of a supposedly novel method of reproducing sound, consisting in forcing a current of air through an air-pervious sound record. If you will look at U. S. patent No. 908,683, you will see that this principle is my invention and dates back six years or more. I inclose a piece of a record such as I used at that time.

Philadelphia, Pa. E. LESCHBRANDT.

The Gyroscopic Action in Aeroplanes

To the Editor of the SCIENTIFIC AMERICAN:

The theory of the correspondent in the April 20th number of your paper, regarding the tendency of a certain flying machine to turn to the left, seems to agree with that I advanced in the March 9th number, but in the interest of truth I would like to say that we are both probably wrong. The solution given by "Canadian Subscriber" in the March 2d number is undoubtedly the correct one. W. G. BLISH.

Niles, Mich.

Mr. Turnbull on the Center of Pressure in Aeroplanes

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of May 18th, 1912, there is an article describing "The New Eiffel Aerodynamic Laboratory at Auteuil," and in it M. Eiffel is credited with a discovery, concerning the center of pressure of a doubly curved surface, that was really made by Turnbull in 1906.

The paragraph to which I refer in your article states that "M. Eiffel has found, however, that by giving the rear portion of the plane a reverse or upward curve, the movement of the center of pressure is reversed. In other words, when the angle of attack is diminished, the center of pressure travels forward, and only travels backward when the angle of attack is increased. This is a result of great practical importance, as it means that by having planes with a reverse curvature, a considerable degree of inherent longitudinal stability is obtained. For example, if a machine in flight suddenly tends to dive, the diminishing of the angle of attack will cause the center of pressure to move forward, and this will give a stabilizing effect tending to lift the forward part of the plane. On the other hand, if the angle of attack is suddenly increased, the backward movement of the center of pressure will tend to right the machine and not allow it to assume too great an angle."

Now, in an article published in the *Physical Review* in March, 1907 (and reprinted in the SCIENTIFIC AMERICAN SUPPLEMENT of January 30th, 1909) I described the movement of the center of pressure with five different types of planes, and drew most particular attention to the inherent longitudinal stability that could be obtained by the use of the double curvature type (No. IV in my article) having concave front and convex rear portion (on the under side).

In fact, my center of pressure curves, my results and deductions are practically identical to those of Eiffel cited above, and obtained patents in the United States, Great Britain, France, and Canada on the "type IV" surface, on account of its inherent longitudinal stability.

While I do not wish to detract from the valuable results Eiffel has given us, concerning many aerodynamical questions, it is only fair to state that, concerning the longitudinal stability of the doubly curved surface, my results antedated those of Eiffel by *fully five years*, as can be very easily verified by consulting the references already given.

W. R. TURNBULL.

A Proposed Solution of the Compulsory License Problem

To the Editor of the SCIENTIFIC AMERICAN:

A number of writers are expressing their disapproval of the compulsory license provision of the patent bill now being considered in Washington.

Could not most of this opposition be appeased if the bill were changed to apply to the purchaser of a patent, and not to the original inventor?

In this way any conflict with the Constitution would be avoided, and the direct object of the authors of the bill just as certainly realized.

The pigeon-holing of patents is not wholly practised for reasons of self-preservation or self-defense, as some would have us believe.

Unquestionably, a vast amount of lawful and beneficial competition is suppressed by this means.

Chicago, Ill. C. W. EISENMANN.

[We fear that the suggestion, while good in intention, is impracticable. The practice of employing dummy directors for corporations shows how easy it would be to circumvent any such law as that proposed. The inventor would simply be used as a tool by his more powerful assignee.—EDITOR.]

Conserving the Atmosphere

To the Editor of the SCIENTIFIC AMERICAN:

While the rapid destruction of our forests and exhaustion of our coal supplies are indeed questions of the uttermost seriousness, I cannot agree with your correspondent, Mr. Thorington Chase (whose letter was published in your issue of May 18th) that the "conservation" of our atmosphere is a matter to cause us the least concern.

True it is that the wonderful increase in the world's industrial activities during the past hundred years, entailing the burning of enormous and rapidly increasing quantities of coal and other fuels, results in throwing off into our atmosphere vast and constantly increasing quantities of carbon dioxide, which, if it were not in some way removed from the air, would in time render human life upon this earth impossible. But just here is where the beautiful balance of nature comes in; for as we increase the burden of carbon dioxide in the atmosphere, we stimulate the growth of plant life, which absorbs the carbon dioxide, "digests" out the carbon, and returns the pure oxygen to the air. In other words, the more carbon dioxide there is in the air, the more rapid and luxuriant will plant growth become, which in turn will return more oxygen to the air. Therefore the only result of artificially increasing the production of carbon dioxide is to stimulate plant growth, and is thus on the whole beneficial to the human race. And further than this, it is not the slowly growing forest trees that are the most efficient purifiers of the atmosphere, but the more rapidly growing annual plants upon which we depend for our food supply.

When your correspondent speaks of the "uncalculated millions" of tons of oxygen which are discarded in slag from our blast furnaces as fixed oxygen, he apparently forgets that any oxygen that goes into the slag does not come from the atmosphere, but from the iron ore itself, where it has already been "fixed" by nature. Practically all our commercial production of iron is from ores which are oxides of iron, containing more fixed oxygen than the resulting slag. Therefore the reduction of such ores tends rather to increase than to decrease the burden of oxygen in the air. True, it comes from the furnace stack as carbon dioxide, but only to be eventually freed from its carbon by plant life.

I would like very much to know upon what information your correspondent bases his statement that "aviators have noticed inexplainable absence of available oxygen in the upper strata of the atmosphere." The presence of an excess of carbon dioxide in the atmosphere could have nothing to do with such a condition, as carbon dioxide is heavier than air, and naturally would lie close to the ground. Of course, the amount of oxygen per cubic yard decreases as we ascend, in the same proportion that the density of the air decreases, but this is surely not "unexplainable."

Philadelphia, Pa. E. J. D. COXE.

Compromise Plan for Upbuilding Our Merchant Marine

To the Editor of the SCIENTIFIC AMERICAN:

Though many views on the subject of the merchant marine have been discussed in the SCIENTIFIC AMERICAN, there is one which I have not seen there, and which I desire to present.

There seem to be three well-defined plans which have been advanced as possible methods of solution of this great economic question. These are ship subsidies, preferential duties, and free ships. Each plan has its merits and demerits, and our problem is to find, if possible, a plan embodying the merits of each system with as few as possible of the defects.

Ship subsidies are distasteful to the American sense of justice; and since subsidies cannot be general, they must constitute more or less of a monopoly. Because of this, and because of the opportunity for graft afforded by direct government assistance to private enterprise, ship subsidies would encounter too much opposition to be applicable.

The chief opposition to preferential duties is, that they would excite similar duties in other countries; but since nearly all governments have some form of public protection already, there should be no reason why America could not do likewise. Another objection is that with preferential duties foreign ships would not be able to compete with the Americans. This is due to Congressman Sulzer's advocacy of a five per cent difference in duties regardless of difference in cost of transportation.

For many years our factories have been protected by a policy of laying such a duty on imported articles that the difference in cost of production at home and abroad is nullified by the tax paid on foreign goods. Under this system our factories have prospered until they are able to do without the tariff. If our merchant marine needs protection, why not protect it in the same way? It is agreed that for various causes, most of them temporary, it costs more to transport goods under the American than under a foreign flag. This is the economic cause which has ruined the American merchant marine. To rebuild our merchant marine, we must remove this cause. The best way to do this is to make the difference in duties between goods brought in American and foreign bottoms such that for every commodity and every voyage it will just compensate the difference in cost of transportation. This will enable American vessels to compete with the ships of all other nations in voyages between American and foreign ports. Such a system of preferential duties, regulated by a board similar to the Tariff Board, would place our merchant marine in a position to compete with the world, while yet preserving that healthy competition which is necessary to any enterprise.

It has been pointed out that with all our shipyards working to their full capacity, it would take twenty years to construct sufficient vessels to carry our trade. Then for a few years some of our ships must be built in foreign yards or transferred from foreign registry. Our problem then is to find the most satisfactory method of admitting foreign-built ships to American registry. The free-ship plan would admit foreign-built vessels owned by Americans to registry without any stipulation as to condition and with no fees. This would force our yards to compete with the oldest and most efficient yards of Europe at a time when they are least able to stand it. Such a method would inevitably lead to the practical annihilation of our shipbuilding industry. Manifestly then free ships are impossible. Then let us find a method which is satisfactory.

It costs less to build a ship abroad than it does at home. This is due to cheaper labor, cheaper materials, and better management. If it costs less to build a ship abroad than it does at home, our shipyards cannot compete on a free and equal basis. Then why not apply those same principles of protection which have been so successful in stimulating our manufacturing industries? Why not lay a tax on the American registration of foreign-built vessels which will just compensate for the difference in cost of production at home and abroad? Under such a system of protection, controlled by the same board which is suggested to regulate our preferential duties, our shipyards would be stimulated by healthful competition without being forced out of business by an economic factor beyond their control. This system would automatically cease when the shipyards of America cease to need it—when the cost of production at home and abroad is equalized.

With the experience which we have had in protecting our factories, it would seem that the application of the same principles to our maritime problems should at least receive careful consideration. Any action which the Government takes on this most important subject must come as the echo of the thought of the people, and we can have no action until the people have considered the question from all sides.

Bergen, N. Y. W. ARNOLD HOSMER.

Lienfoss power station.

Factories at Saaheim.

A Mammoth Norwegian Power Plant

Telemarken's Great Industry

NORWAY has entered the ranks of the countries which are devoted to huge industries. Throughout the country there is evident a feverish ambition and energy toward being up and doing. Great new factories are being built, and Norway's famous old water-falls ("Foss") are being harnessed for commercial use. Largest and most imposing of all, in this connection, are the enterprises which derive their power from the plant at Rjukan, the immense industrial works which lie between Mosvand and Hitterdalsvand.

In the course of the last year, principally at the initiative of Mr. Eyde, general director, a number of water-power plants have sprung up in Norway. Among these are the plants at Tysse, Boilefoss, Vammafoss, Lienfoss, Svaelgfoss and Rjukanfoss. These plants are to serve electro-technical science and industry, and the harnessing of the waterfalls may be said to mark a turning point in the economic development of the country.

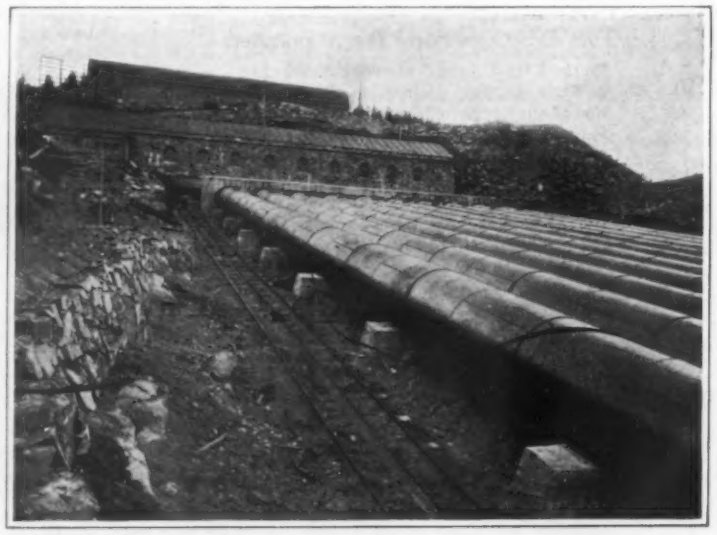
The last three of the above mentioned water-power plants, Svaelgfoss, Lienfoss and Rjukanfoss, are all built exclusively for the manufacturing of saltpeter—Norwegian saltpeter, as it is called, in distinction from Chili saltpeter. Chili, as is well known, has hitherto been the only country from which this absolutely necessary product could be obtained for agricultural fertilizing purposes.

Of the three plants Rjukanfoss is the largest and the most impressive. With its 145,000 horse-power, it is one of the world's great power plants. Not even the plants which are located at Niagara have so powerful and extensive a system. When the other plant, Rjukan No. 2, is completed an additional 125,000 horse-power will be obtained, so that the power utilized here will be 270,000 horse-power, which is more than half of the combined power that once sufficed for all of Norway's industries put together in 1909, viz., 533,758 horse-power.

This is the world-famous Rjukanfoss of Norway, the power of which has thus at last been harnessed. The huge "Kettle" situated under the falls, from which the water rose perpendicularly into the air, and from which the old "foss" sent its powerful bass-voice out over the valley in an everlasting monotonous hum, is now almost entirely dry, and not a sound is to be heard. Where the old mythical Maristi, famous in saga and folklore, almost "hung" down from the side of the mountain, there is now to be found a broad wagon road running into and along it.

In order to supply permanent water-power the year round, the Moswater situated in the mountains has been walled in and dammed up. Not less than 28,250 million cubic feet can here be kept back and collected when the snow thaws in the springtime, and the waters from the mountains rush down toward the valley. In this way the river Maana, which forms the outlet for the waters of Moswater, throughout the entire year can be made to flow along with a velocity equal to 1,660 cubic feet per second, and the power station in this way is enabled to furnish always the same amount of energy to the factory.

Moswater is, without exception, the greatest water reservoir in Europe, and in the entire world it is excelled only by the mighty Assuan dam over the Nile, in Egypt.



Pipe lines running from reservoir dam 870 feet to power station.

Rjukan power station with pipe line.

About 6.2 miles below Moswater, and 1.9 miles above the old Rjukanfoss, at Skarsfoss, the entrance to the power station Skarsfosdammen is situated. Here commences the 3-mile long tunnel. One huge fall rushes downward, with a number of smaller falls augmenting it in its course, and the tunnel runs along the mountain side slightly leaning inward, until it winds up in an open basin about 3,610 feet wide and 49.2 feet deep, blasted out of the mountain. From this the water is taken and carried through ten conduits about 5 feet in diameter, down to the turbines in the power station called Rjukan Power Plant No. 1—dropping in their course about 950 feet perpendicularly.

If the machinery in the power station is to be stopped, the penstocks are closed, whereby the water is liberated out over the mountain-side. Nearly 1,640 feet vertically measured, the water falls down before it reaches the river at the bottom of the valley. It is the "new" so-called Rjukanfoss which is thus being artificially created through technical skill and human ingenuity—a fall even more impressive than was the old Rjukanfoss.

From the power station the water is once more led into the tunnel, situated in the mountain-side, and carried about 3 miles downward to the other power plant, Rjukan Power Plant No. 2. However, as long as Rjukan No. 2 is incomplete, the water from Rjukan No. 1 continues to fall 328 feet perpendicularly downward to the river, at the bottom of the valley.

Each of the turbines in the power station represents 14,500 horse-power. This is one of the most gigantic water systems of its kind in the world. The turbines are coupled directly to the generators. It is this machinery which furnishes through conduits to the factory the electrical current which runs them.

Between the power station situated at Vemark and the saltpeter factory at Saaheim is about three miles. Above, at the station, not much is to be seen of the five to six thousand people who have moved into the valley; for the service necessary for the plants is comparatively small—only about 40 to 50 men being required.

If, however, we follow the development downward into the narrow valley, we soon encounter at a few miles the new town called Saaheim.

The power conduit in the factory enters it through the "furnace house" so-called. Here the electric furnaces are located, partly erected by Birkeland-Eyde, and partly of German construction. In these furnaces great electric flames burn, and air is forced into them with great velocity.

Owing to the electric flame and the high temperature which prevails in the furnace, the elements of which the air is composed are in part forced to combine with one another in a peculiar chemical compound, while the air in its natural state consists only of a mechanical blending of various gases, and where, therefore, each variety of gas exists separately. By the chemical combination of these two elements nitric oxide is produced, which forms the basic principle for the making of nitric acid, and through this, of saltpeter proper. In order to manufacture saltpeter, a big apparatus is, however, required, because the gases which are liberated from the furnace with a temperature of several hundred degrees Centigrade must be cooled and subjected to a prolonged chemical process, before being converted into nitric acid.

The cooling takes place in the following manner: The hot gases are carried through the fireboxes and boilers. The steam which thereby is produced is again utilized as motive power for pumps, locomotives, etc., and for the further manufacturing of the product. The most imposing feature in the entire manufacturing process is, however, the great absorption towers, in which the gases are converted through water into nitric acid. These colossal towers are built of granite, they are ten-cornered, about twenty-three feet across and over sixty-six feet high. Within the tower, which has a floor area of 75,350 square feet and a height of about ninety feet, stand no less than 32 huge granite towers, besides many additional iron towers and machines. The tower proper is so large that the royal palace, which stands in the royal park at Christiania, could be placed within it.

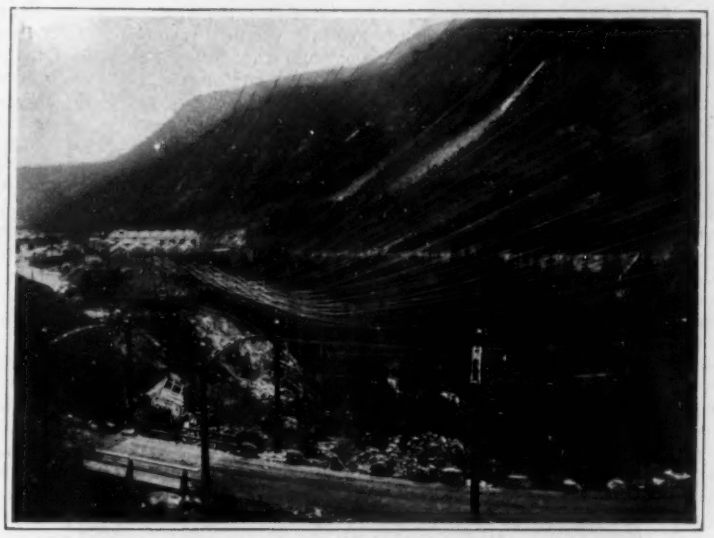
The saltpeter is manufactured by a process through which the nitric acid is led over limestone, which in this way is decomposed. The decomposition is thereafter saturated with live steam from the above-mentioned coolers, until the complete mass becomes a solid, which thereupon is powdered and packed into barrels ready for shipment.

The factory has its own mechanics' workshop, and, of course, a barrel factory, which last named can produce upward of 6,000 barrels in 24 hours.

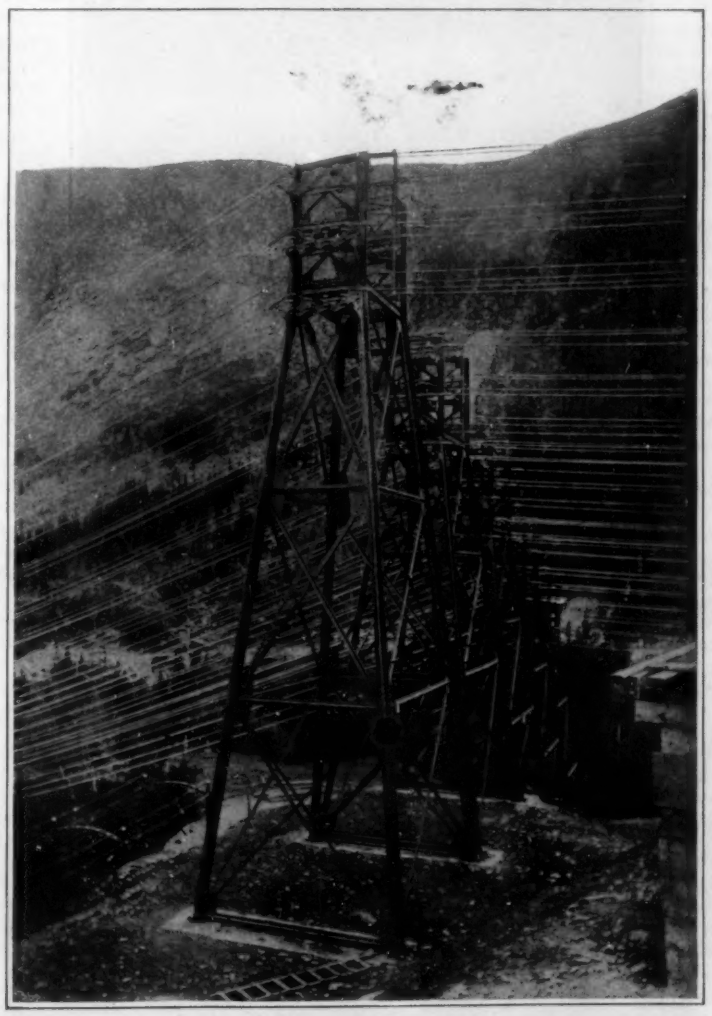
On the other side of the river lies the town of Saaheim itself. It has about 5,000 inhabitants, and will, presumably, in the course of a few years, when the other great plant, Rjukan No. 2, has been completed, grow to more than twice its present number of inhabitants. The company has invested heavily in the town, modernizing it in every respect, and it makes throughout a solid and comfortable impression. The houses are for one, two, and four families. Of late "Own Home" houses have been also built, for which the company supplies easy loans to its workmen, engineers, etc. Water pipes are installed throughout in the new houses, also laundry and modern water closets. In the same way modern streets and roads have been built with up-to-date sewers, etc. Electric light is, of course, installed everywhere.

On the same side as the factory, just below it, lies Saaheim railroad station. For shipment of goods to and from the factory the company has built its own electric standard gage railroad, all the way from Notodden and up to the ferry connection, Rollo ferry, so called, over the beautiful Tinn Lake, where the railroad cars are transported across directly on the ferry. The railroad is 28.6 miles long, and the ferry connection over Tinn Lake is about 22 miles. The Tinn Lake is regulated by a dam called Tinnosdammen. The Tinn River is dammed up through the magnificent Svaelgfoss, making a large sheet of water, which now is called Kloumannsj Lake. Here lies, directly under the dam, deep down at the old river bottom, the large Svaelgfoss power station, which sends its 40,000 horse-power in a colossal power conduit to Notodden. This plant is comparatively the cheapest in the world of its kind. On the road to Notodden 15,000 horse-power is brought from Lienfoss power station into the same conduit and carried by Tinnfoss down to the factories of Notodden, where saltpeter is also manufactured. At Notodden the product is shipped to the company's huge warehouse and shipping point, Menstad, down by Skienselven. When in the course of a few years—as it is reasonable to presume—the present canal at Skien, Notodden, is widened, the sea-going ships will be able to go straight up to Notodden, and it will, without a doubt, not be long before all the other waterfalls in Telemarken are harnessed for industrial use as well.

In Norway are to be found many dormant natural riches, which, however, hitherto have been considered too poor or of too small a yield to be able to take up the competition with those of a similar nature in other countries. Through the development of electro-technical science of later years, the cheap motive power which the waterfalls of Norway have supplied, will undoubtedly enable her in many directions to take up the competition with the old industrial countries. One must, however, not lose sight of the fact, as is often done, that it is not alone the motive power which plays a dominant and deciding part in the industrial development of a country; other factors have to be reckoned with in the final analysis, among which are shipping facilities and cost, freight, labor conditions, taxes to state and community, etc. These very often are just as important as the first. It is, therefore, of vital importance that the country should endeavor to create for its new industries that are trying to get a permanent foothold there, as good and cheap transportation and similar accommodations and attractive labor conditions as possible. Regard must also be had for the people who make their energy part of the enterprises, identifying themselves with the works. If this is done, without a doubt, before long the great plants in Vestfjordsdalen will be followed by others of equal magnitude and as important for the country.



Thirty-Two Aluminium cables leading to the factories at Saaheim.



Towers for aluminium cables.

Academic Freedom in the Orient

IN wonderful contrast with our most distinguished seats of education, El Azhar, the celebrated university of Cairo, the greatest and oldest high school of the Mohammedan world, recently passed the thousandth year of its existence. But unlike our universities, of which the systematic management is always a brilliant phase of their progress, this educational focus of the Orient is also a remarkable example of a really unrestricted, perfect academic freedom. All tribes, peoples and races are represented in the body of students embraced by the university, the number of the last never being the same, but fluctuating between 2,000 and 3,000. This extraordinary alma mater, it must be said, can awaken and retain the affection and loyalty of students with greater ease than any other university, for in very numerous instances the object of the avowed disciples of her particular cycle of sciences who enter the consecrated halls of El Azhar is not merely to attend the lectures, their residence and work between the walls of the university being really a portrayal of their whole lives. Even the barbers have a permanent station in the great vestibule, so that these special students do not need to leave the university in any event.

The heart of the institution is the great court which is splendidly paved. Upon it scores of little doors open and loggias and balustrades in great number abound. As an architectural entity it is a picturesque oriental masterpiece. Those students who with least ease can pay for a small cell in the university incur no expense for the spaces on which they sleep under the roofs of the great open social hall. There is no fee for matriculation, and there is no obligation to pass any examination. Unsubjected to tests and omitting any stated conclusion of study there go forth from El Azhar orators, lawyers, physicians and poets, many a man among them having lived for decades within the precincts of this alma mater. The teachers and professors receive no salary or other strict compensation; they live on the voluntary dole and presents of their pupils, on the meager price of private instruction, and on the fees they receive for copying old books and manuscripts. There is no faculty that calls the professors, no authority that appoints them; every pupil of the university can establish himself after a few years of study independently as a teacher in the halls of El Azhar, begin to lecture and to teach the truth as he knows it or believes he knows it. And under such apparent laxity of administration the great university continues an existence that is by no means precarious. In the opinion of its staunch friends, of its beneficiaries, and of the young men who are waiting to throng to its halls, its authority and importance are more obvious and brilliant and impressive now than ever before.

The zeal and loyalty of the students who are leaving it at frequent and irregular intervals are incomparable, and are the source of a later rivalry, in business and profession, of such strangeness, prodigious keenness and persistency as must astound the occidental student who may be quite unfamiliar with oriental customs and who is graduated only in strict accordance with the sheer system that prevails during an arduous curriculum, and is, therefore, much more evenly equipped for frank competition.

Henri Poincaré

The Passing of a Great Mathematician and Philosopher

By J. W. N. Sullivan

THE nineteenth century has been aptly called the age of science. It is not that that century surpassed all others in the magnitude of its discoveries, but that scientific results and scientific methods were then, for the first time, brought home to the minds of the people. The general interest taken in the theory of evolution, consequent on the publication of the "Origin of Species," extended to other branches of science. One great cause which contributed to the general spread of scientific ideas at that time was the part taken by some of the foremost scientific men in presenting their results in a form devoid of technicalities, and in such a way as to be readily understood by the average man. Since that day we have had innumerable popular expositions of every branch of science. Indeed, the writing of popular accounts of scientific discoveries has almost taken rank as a distinct profession. Such writers usually confine their efforts to explaining recent positive discoveries. But of late years something far more interesting than any isolated discovery, however wonderful, has taken place. We are in the midst of a general criticism of scientific procedure, and of the value of scientific results. The scientist has grown uneasy. He is no longer sure of the very foundations on which the whole vast superstructure of modern science is erected. To present these intricate questions, these subtle and far-reaching issues, in a form which renders them readily understood of the average man, requires the hand of a master.

In the domain of mathematics and physics, at any rate, the master appeared. In the late H. Poincaré we had a genius of the first order, a man whose accomplishments in his chosen sphere earned him a foremost place among his contemporaries. By many competent authorities he was considered to have been the greatest mathematician of our day. It would be impossible in the space at our disposal to give an adequate account of Poincaré's work in mathematics, mathematical physics, and dynamical astronomy. We here wish to call attention to his three books, "The Value of Science," "Science and Hypothesis," and "Science and Method."

These works are, in a large measure, critical rather than expository. They contain the profound reflections of their distinguished author on questions of the first importance, and yet are written with such clearness and charm of style that they may be read with pleasure and profit by any ordinary thinking man.

Take, for instance, mathematics, the most impeccable of the sciences. Poincaré sees that its very existence appears paradoxical. We start from definitions and axioms, and deduce consequences which are absolutely necessary results of our premises. We introduce no fresh facts. We make no appeal to experiment. How then can we discover new truths? It would seem that all mathematical reasoning must reduce to a gigantic tautology, and that all the mathematical theorems which fill so many imposing works are simply various ways of saying that A is A.

Poincaré analyzes this paradox and shows that the very essence of mathematical reasoning, and that which alone makes it valuable, is the principle of mathematical induction. This great principle affirms that if a theorem is true of the number 1, and if we can further assert that, being true for the number n, it is true for $n + 1$, when we have proved that the theorem is true for all integer numbers. This principle is, in one way, a kind of short cut. It enables us to dispense with the labor of verifying the theorem for every particular case, and is the fundamental characteristic of mathematical reasoning. It alone makes generalization possible.

Again, we all know what great changes have occurred in our way of looking at the fundamental concepts of geometry. Since Lobachevski and Riemann have shown us that it is possible to construct perfectly logical and consistent geometries quite unlike Euclid's, the question has arisen in some minds, which geometry is true? For instance, according to Euclid's geometry the three interior angles of a triangle are together equal to two right angles; according to Lobachevski they are less than two right angles, and according to Riemann they are greater than two right angles, and these differences increase with the area of the triangle. Suppose then we effect some astronomical measurements by measuring the angles of the very large triangle formed by the diameter of the earth's orbit and the lines joining its extreme points to a fixed star. If we make our measurements with sufficient accuracy, it would seem that we should be in a position to answer the question, which geometry is true? Poincaré shows us that this is not the case. In making our measurements we have implicitly assumed that light is propagated in straight lines. If we found that the sum of our measured angles was not equal to two right angles, we should not change our geometry, *we should simply conclude that light is not propagated in perfectly straight lines.* We should do this because it would be more *convenient.* This is the key-note to Poincaré's treatment of this subject. It is meaningless to talk about the *truth* of geometric theorems. It is as meaningless as to talk about the *truth* of the metric system. The theorems are necessary consequences of the preliminary hypotheses, and these hypotheses are *arbitrary.* We have selected those we have in preference to others because they most nearly and most simply accord with the observed facts relating to solid bodies and are, therefore, the most convenient.

HENRI POINCARE

We have not space here to give an account of Poincaré's profound remarks on the subjects of space and time, those old bugbears of metaphysics. Suffice it to say that he treats all such questions with unrivaled insight and ability. On the subject-matter of physics proper his views are equally striking and original. He points out that in the accepted theory of matter, the electron theory, Newton's third law, asserting the quality of action and reaction, does not hold unless we assume a reaction on the ether which gives the necessary compensation. This fact is of fundamental importance. On analyzing our concept of energy, one of the most important concepts in the whole range of physics, he succeeds in showing that except in a few comparatively simple cases it is very hard to define, and that a general definition simply reduces to saying that in any physical phenomenon there is something which remains constant. This notion of energy, in fact, belongs to a class of hypotheses which are distinguished by the fact that they can never be contradicted by experiment. Then there are two classes of hypotheses in science—those which may be submitted to the test of experiment and judged by their behavior under that test, and those which serve us as general controlling principles, but which are outside the range of experiment. Poincaré illustrates this difference very clearly, and an interesting example, taken from biology, has been given by Prof. Royce in his introduction to the American translation of "L'Hypothèse et la Science." This extremely inadequate sketch of the subject matter of Poincaré's popular expositions will, we hope, induce the reader to make the acquaintance of the volumes mentioned. He will find himself amply repaid for his trouble.

Like many other great men, Poincaré manifested his extraordinary powers at a very early age. He was born in Nancy in 1854, the son of a French physician. As a boy he was rather delicate, and disinclined for the society of other boys of his age. He seems to have been a very engaging child and wonderfully intelligent. He was trained first as an engineer, and received his doctorate in mathematics at the age of twenty-five. But he had very early given proof of his extraordinary mathematical powers. It is related that he never took notes of the lectures which he attended, nor did he ever read the copies of the lectures which were distributed among the students. He simply made a mental note of the results given by the professor, and when called upon, could always supply a proof of his own. Like many other people who are in the habit of indulging in intense mental concentration, he did very peculiar things. He was very fond of walking while engaged in thinking out his problems, and had a habit of "fiddling" with something in his hand. This was so well known at the college where he was a student that the professor gave him a bunch of keys to carry as he paced the corridors in meditation. On one occasion he was discovered on one of the principal streets of Paris carrying a large new wicker-work basket in his hand. He suddenly became alive to the fact, and retracing his steps, found that he had unconsciously purloined the basket from a store he had passed some time previously. It is also related that he was once found packing his trunk with the bed-linen of the house where he was a guest under the impression that he was packing his handkerchiefs. The histories of other great mathematicians, such as Gauss and Lagrange, show that intense mental concentration is often accompanied by this peculiar state of oblivion to the external world. In fact, at times, as in the case of Sir Isaac Newton, it has given rise to temporary suspicions regarding their sanity. Poincaré was a well-known figure in Parisian society, and was by no means the retired mathematical recluse of popular imagination. He was a member of the French Academy of Literature, an extraordinary honor for a scientific man, and a member of a great number of scientific societies in various countries. His published works embrace nearly every branch of pure and applied mathematics. His work in dynamical astronomy is of great value. Among other things, he has made contributions to the famous problem of three bodies which are of the first importance. In general function theory he has created a new type of functions. Together with Klein he has applied some of the concepts of the new geometries to the integration of linear differential equations, and he has greatly helped to develop the branch of mathematics known as Analysis Situs.

It is of the greatest interest to know the way in which the mind of a great man works. On this point Poincaré has given us some most illuminating information. There appear to be three stages in the solution of a problem: first, a period of intense mental effort, usually unsuccessful; secondly, a complete mental rest from that particular problem; and thirdly, a sudden revelation of the solution, followed by a period of conscious effort, trying to find the proofs of the answer revealed. We say *conscious* effort, because Poincaré himself believes that the period of apparent mental rest is in reality a period of intense activity, the activity of the subconscious self.

The first period of intense mental activity seems analogous to setting a number of things in motion, which then proceed to form combinations among themselves. The question why the correct combination, and no other, is presented to the conscious mind, does not permit of any very satisfactory answer. But it is significant that the right combination is the one which most appeals to the aesthetic sense of the mathematician, and there is probably a deep relation between the correctness of a theorem and its mathematical beauty.

A seedling being helped by borrowed roots.

The seedling when first inarched on the nurse plant.

The seedling soon feeds from the nurse plant.

All the vigor of the older plant is sent into the single shoot of the seedling.

Hurrying Nature

A New Method by Which Trees That Fruited in Eight Years are Made to Bear in Two

By William Atherton Du Puy

A METHOD of hurrying trees to their period of fruiting has been discovered at the Government hothouses at Washington. There the men who juggle with living plants and make them do things of which nature never dreamed, have recently succeeded in diverting the vigor of trees that were large and strong, sending their sap coursing through the veins of spindling seedlings and thereby caused those seedlings to do in two years what ordinarily would have taken eight.

Take for example the finger lime of Australia. This is an exceedingly rare plant. Three years ago it had not a representative in America. About that time somebody sent three seeds of the finger lime to the Department of Agriculture. These were planted immediately and all grew. Being the seedlings were of the lemon family the scientific growers knew that it would require eight years for the finger lime to come into bearing under normal conditions. Eight years is a long time to wait in an experiment.

At just this period the new method of diverting the vigor of other trees into a seedling was in the course of being established. The process is known as "inarching." One of the finger lime seedlings was inarched upon a vigorous two-year-old lemon tree. All the strength of that tree was diverted into the slender shoot. In two years it had ripened its fruit and the scientists were able to judge of its quality. Further, they were supplied with additional seed with which to start new generations of plants.

This shortening of the fruiting time of plants is of inestimable value to the scientific developer of fruits. The breeding of fruits is one of the most fascinating of the modern sciences, and the results that are just now being obtained read like the romances of conjurers. The greatest stumbling block in the way of the working out of these modern miracles has been the length of time required in producing successive generations of a given plant. It has often happened that a scientist has died before he has accomplished the end for which he has set out. But now the time is to be cut to one fourth, and the probabilities are that results will be, in the coming generation, multiplied a hundred fold.

The inarch is accomplished in this way: The seedling is grown to the age of but three or four weeks. It is a weak little plant of but four or six leaves. Nature has stipulated that many years must pass before it comes to maturity, blossoms and bears fruit. Under the inarch process this stripling is taken up with a ball of earth about its roots sufficient to maintain its life for a few weeks. The whole is transferred to a stalwart vigorous tree of a kindred species. This tree may be two or three years old. Its roots are deep. It is supplying sustenance for a top that is a hundred times as large as the seedling.

This is known as the nurse tree. The outer bark is scraped from the side of the nurse tree a foot above the ground. The outer bark is likewise scraped from the seedling. The two wounds are bound together with soft cloth bands. The ball of dirt on the root of the seedling is bound to the side of the nurse tree. In two or three weeks the plants have grown together. The dirt from the roots of the seedling may be removed. It is now drawing its vigor from the nurse tree. Eventually its roots are cut off smoothly below the point of union. The nurse tree has taken the little orphan plant unto itself.

But this is not the end. After the union is thoroughly established the plant juggler cuts the top off the great vigorous nurse tree. Then is all the nourishment that was going into its top diverted to the single small stem. Then do its roots which have been establishing themselves deep in the soil for years send their vigor into the small seedling. The result is such growth as nature never knew. The twig has such an abundance of nourishment that it vents some of it in fruiting before its time. And this early fruit is strong and vigorous, showing the utmost possibilities of the tree.

There are scores of experiments which the Department of Agriculture has had under way for many years, that have been worked through the slow cycle of generations of plants, but may now be hurried by means of the new method. There is the citrange, for instance. The citrange is a hybrid fruit. It was obtained through that scientific development in fruit breeding that has been going on for the last decade and which has as its basis the cross-fertilization of kindred fruits.

The orange, the grapefruit, the lemon, the tangerine, even that ornamental plant known as the mock orange or Japanese orange, all belong to the same family. Their relation is so close that they may be cross bred. Plants may be cross bred by shaking the pollen from the flower of one into that of the other. The process in nature is brought about by bees carrying the pollen from one flower to the other. So the scientist, wishing to cross certain varieties, prevents the fertilization of the flowers by the bees by putting paper bags over the given blossoms. Then, when the time is ripe for the experiment, he removes the bags, shakes the pollen from the flowers of the one plant into those of the other and puts back the paper bags. The seeds that result from the fruit from these flowers will be a cross between the two plants used in the experiment. They may be planted and the hybrid fruit grown. This is just what has been done between the ordinary orange and the mock orange. The mock orange is a cold-resistant plant. It will grow as far north as New York. The great difficulty with the oranges and citrous fruits in general is that they can grow only in communities not visited by frost. So the scientists have sought to cross the cold-resistant branch of the orange family with the branch that produces the best fruit and thus secure a plant that will produce a good fruit and will also grow in a cold climate.

Now a hybrid seed so obtained requires, under the methods of unaided nature, the accustomed eight years to bear fruit. A wait of that length of time is necessary before the experimenter knows

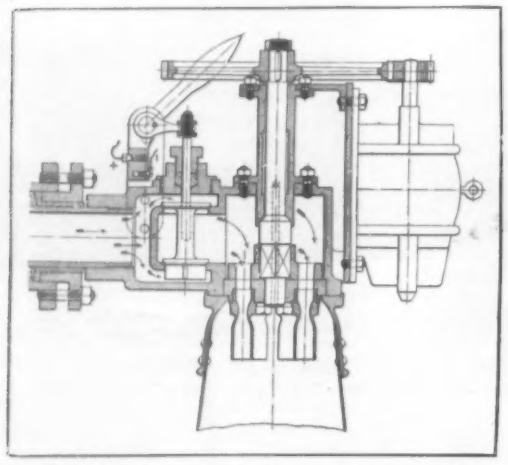
(Concluded on page 86.)

A nurse plant with its arms full of seedlings, shortening the fruiting time.

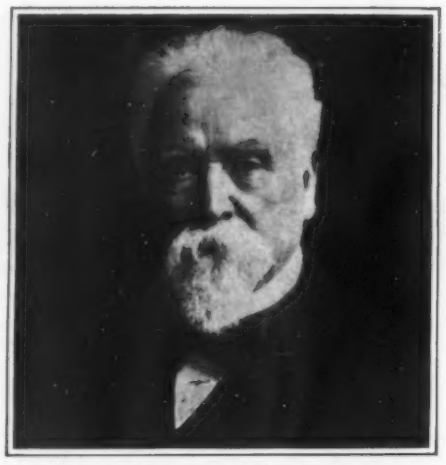
Australian finger lime, the first of its kind ever grown in America, was hurried to fruiting by means of the inarch.

Inventions New and Interesting

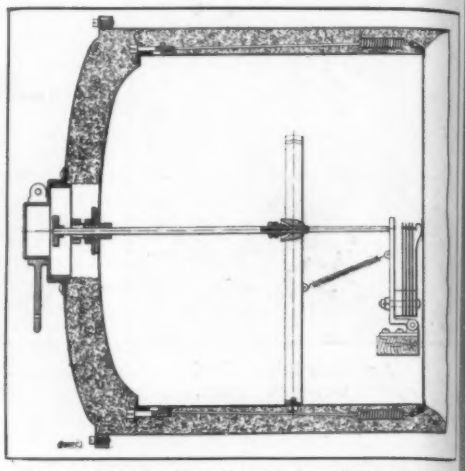
Simple Patent Law: Patent Office News: Notes on Trademarks



1.—Vertical section of vibration-producer. The disk rotates at a uniform speed, so as to give a note of constant pitch. The steam enters the central pivot, passes through the balanced valve and escapes through the expanding nozzles into the small end of the trumpet. The balanced valve is controlled by means of a handle; and the opening and closing of the valve makes and breaks the circuits.



2.—Sir Hiram Maxim, whose latest invention is here described in his own words, believes that it is possible to avoid such disasters as the sinking of the "Titanic" by causing obstructions in the path of a vessel to reflect vibrations produced on the vessel itself. The reflected vibrations are caused to act on sensitive instruments installed on the vessel.



3.—Apparatus for converting the inaudible waves of the echo into audible sounds. Atmospheric vibrations cause a diaphragm to vibrate like a drumhead. In moving it makes and breaks electric circuits and causes bells of various sizes to ring. The pressure of air in front of the diaphragm produces a corresponding pressure inside of the cylinder.

Preventing Collisions at Sea

A Mechanical Application of the Bat's Sixth Sense

By Sir Hiram Maxim

THE wreck of the "Titanic" was a severe and painful shock to us all; many of us lost friends and acquaintances by this dreadful catastrophe. I asked myself: "Has Science reached the end of its tether? Is there no possible means of avoiding such a deplorable loss of life and property? Thousands of ships have been lost by running ashore in a fog, hundreds by collisions with other ships or with icebergs, nearly all resulting in great loss of life and property."

At the end of four hours it occurred to me that ships could be provided with what might be appropriately called a sixth sense, that would detect large objects in their immediate vicinity without the aid of a searchlight.

Much has been said, first and last, by the unscientific of the advantages of a searchlight. Collisions as a rule take place in a fog, and a searchlight is worse than useless even in a light haze, because it illuminates the haze, making all objects beyond absolutely invisible.

Some have even suggested that a steam whistle or siren might be employed that would periodically give off an extremely powerful sound, that is, a veritable blast, an ear-piercing shriek, and then one is supposed to listen for an echo, it being assumed that if any object should be near, a small portion of the sound would be reflected back to the ship; but this plan when tried proved an absolute failure. The very powerful blast given off by the instrument is extremely painful to the ears and renders them incapable of hearing the very feeble echo which is supposed to occur only a few seconds later. Moreover, sirens or steam whistles of great power are extremely objectionable on board passenger ships; they annoy the passengers and render sleep impossible. It is, therefore, only too evident that nothing in the way of a light or noise producing apparatus could be of any use whatsoever.

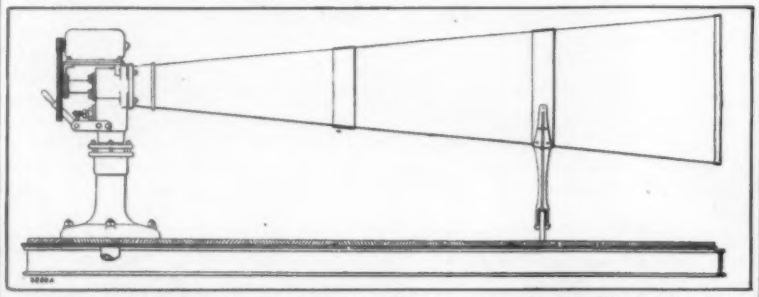
Experimenters are fully agreed that the bat possesses what might very properly be called a sixth sense, and that it is able to pursue and capture small insects in the dark under conditions in which eyes would be of little or no use. It is a very curious fact that, notwithstanding that the organ of the sixth sense is the most conspicuous organ possessed by the bat, none of our scientific men have discovered it. It was evidently *too* apparent to be observed, and reminds one of Christian in "Pilgrim's Progress" who was digging in the muck for a crown when the crown in question was directly over his head and very conspicuous. In many cases, the organ that gives the bat the sixth sense is spread all over its face. In the vampire bat the organ is on the tip of the nose; it stands up in the air, and is called the "shield," but in most of the small bats that catch insects on the wing, we find two little leaves, not unlike the wings of the insect that it pursues, standing up just in front of the ears. Others have the sensitive spots located on other parts of the face.

Let us see now what takes place, and what it is that enables the bat to fly about through all manner of obstructions without touching anything, after the manner of a swallow. What enables it to pursue a fly or a beetle in a degree of darkness which renders eyes useless?

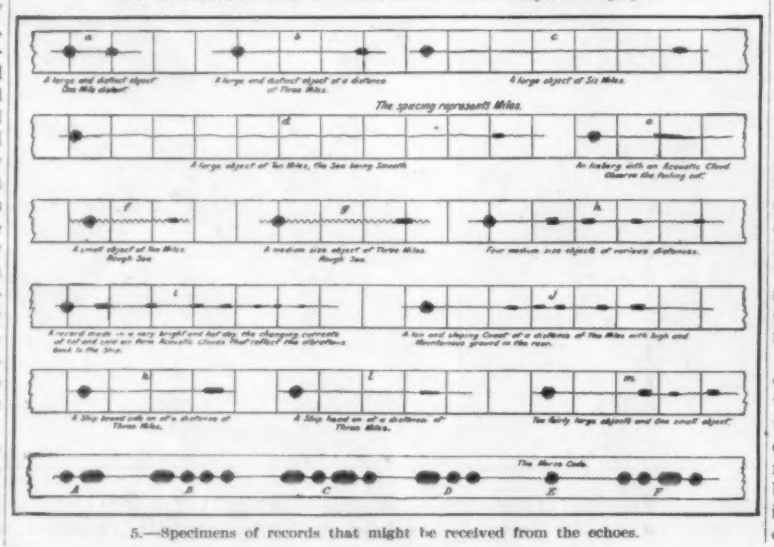
In the bats that feed on swiftly flying insects, we find that this small organ is about the shape and size of the wing of the insect on which it feeds. The beat of the insect's wings is communicated to this organ and enables the bat to follow the insect and seize it without seeing it. This is very simple and easily understood, because the insect itself produces certain atmospheric vibrations to which the little leaves in front of the bat's ear respond, but when we come to inanimate things that give off no vibrations of themselves, how does the bat know of their presence? How is it able to judge of their character?

It has already been shown that the wings of the bat are extremely sensitive and very well provided with nerves, and the same is true of the various organs on the face; of course, all of these are intimately connected with one another, and also with the brain of the bat. When a bat flies about in total darkness, the beat of its wings sends out a series of pulsations or waves after the

This article is abstracted from a volume published by Cassell & Company, Ltd. For lack of space it has been impossible to present in full the author's ingenious arguments for supposing that a bat really can project vibrations and guide himself by their reflections from surrounding objects under conditions that render the use of the eyes impossible. Moreover, we should like to see the arguments made substantiated by experiments conducted by some competent modern biologist. Sir Hiram's apparatus, however, is based on sound mechanical and physical principles and needs no biological analogue to convince one that it is sound. The reader is referred to Sir Hiram's book for a complete description of the instruments described and of their operation. We can give here only the barest outline.—EDITOR.



4.—Side elevation of the complete apparatus. The trumpet can be turned in any direction. For short-distance work a smaller, bell-mouthed trumpet is employed.



5.—Specimens of records that might be received from the echoes.

manner of sound waves, but of too low a frequency to be considered as sound. These waves strike against all surrounding objects, and, like sound or light, are reflected back to their source of origin. The wings send out the vibrations or impulses and they are reflected back and received by the sensitive organs which form a part of the face of the bat. The extremely delicate nature of the bat's wings, together with the sensitiveness of its organ of the sixth sense, enables it to judge the distance to any object by the lapse of time between the sending out and the receiving of the waves, because it takes some time, some fractional part of a second, for a wave to travel from the bat's wings to the object and return to the bat's face.

We know that this is the mechanism that gives to the bat what is practically a sixth sense. We know it must be true because it cannot be otherwise. That the bat possesses this power is completely beyond dispute, and this is the only way that it can be accomplished. But all bats do not possess this organ; the fruit-eating bats that do not fly about in total darkness have large eyes and never possess this organ, although in some cases we find the rudimentary remains of the organ which they have inherited from their early ancestors, the same as we have inherited the Darwin tip.

The energy employed by the bat is certainly not more than one-thousandth part of a horse-power, but it serves the bat's purpose perfectly well.

Suppose, now, that we construct an apparatus that will produce atmospheric vibrations of about the same frequency as those produced by the bat, but instead of using the infinitesimal amount of energy employed by the bat, we use two or three hundred horse-power—that is, we send out waves that have an amplitude and energy at least three hundred thousand times as great as those sent out by the bat. These vibrations, although of great energy, will not be audible to our ears, but they will shake up and agitate light objects for a considerable distance, and will travel at least twenty miles, so that they could be received and recorded by a suitable apparatus at that distance, and would be able to travel at least five miles and send back to the ship a reflected echo that would be strong enough to be detected.

The quantity of steam required would not be very great, because the valve would not be opened very often, and when open would not remain open more than a second at a time; therefore, the total amount of steam required while signaling was actually going on would certainly not exceed ten horse-power.

The apparatus could also be used for communicating with other ships by giving off long and short blasts representing the dots and dashes of the Morse system.

In providing a ship with a sixth sense, we have to consider three distinct devices: one for producing and sending out the necessary waves, one for receiving the reflected waves and making them audible by ringing bells, and another apparatus for recording the amplitude of the waves.

For producing the vibrations of waves, I prefer to use a modified form of a siren, the disk being rotated at a suitable speed by a motor of some kind, preferably an electric motor. I prefer to use a very high pressure of steam, to have all the parts large and strong, and to produce about fourteen or fifteen vibrations per second. These will not come within the range of the human ear, consequently they cannot be considered as sound, and as they are of great amplitude and power they are able to travel over great distances, and when they come in contact with a body, the waves are reflected back to the ship in the same manner that sound would be reflected back, but this echo would not be audible to the human ear. I, therefore, provide an apparatus which might be considered as an artificial ear. It is provided with a large diaphragm tightly drawn over a drum-shaped cylinder, and so arranged that the atmospheric pressure is always the same on both sides, quite irrespective of any air blast. It is, therefore, always able to vibrate freely in response to the waves of the echo, and its vibrations are made to open and close certain electrical circuits which ring a series of bells of various sizes. If, for example, the object is very small or at a very great distance from the ship, a very small bell rings, while a large object at a distance of two miles would ring a larger bell, and a very large object a still larger bell. This apparatus gives an audible notice if anything is ahead of the ship.

The other apparatus is similar, but instead of ringing a bell it produces a diagram of the disturbances in the air—that is, when there is no noise except that due to the action of the ship or the sea waves, a wavy line is produced; but whenever the vibrations sent out by the vibrator strike an object and return, the wavy line on the paper becomes very much increased in amplitude so as to be easily observed, and the distance that the object is from the ship can be measured by the length of the paper strip between the giving off of the vibrations and the receiving of the echo; therefore, the distance can be determined with a considerable degree of nicety, and the size of the object may be determined by the amplitude of the waves that return.

Very extensive experiments were conducted about forty years ago by Prof. Tyndall at the South Foreland. He found that a deep note emitted by a powerful siren traveled a very long distance, and he was rather surprised at the volume of sound that was reflected back from a ship. At that time it was generally supposed that snow, rain, and fog were very unfavorable to the travel of sound, but in his experiments he found that such was not the case. The most unfavorable weather for sound is when the sun is shining brightly and when the air is optically perfectly clear. Under these conditions, we have heated air rising up from the earth, and cooler air descending; this produces a kind of a glimmer in which it is very difficult to sight a gun at long range with any degree of exactness, but my apparatus would not be needed in this kind of weather.

It is well known that the air around a large iceberg is extremely cold—in fact, so cold that certain scientific men have thought that it might be possible to detect the presence of icebergs by the use of a delicate thermometer; but the cold air does not extend far enough around the iceberg to make this practical. Cold air, however, lends itself admirably to the use of my apparatus, because the air itself about the iceberg, being of a different density from the surrounding air, acts as a reflector returning the vibrations to the ship.

In Prof. Tyndall's experiments I find the following:

"In the experiments at the South Foreland, not only was it proved that the acoustic clouds stopped the sound, but that the sounds which had been refused transmission were sent back by reflection."

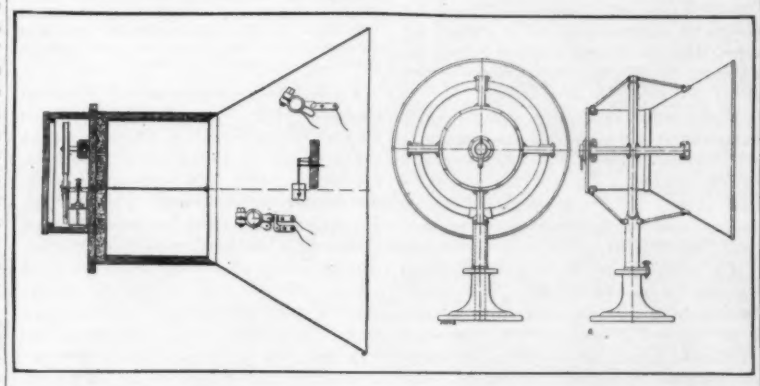
The apparatus for producing the atmospheric vibrations should be placed well forward on the main deck or in any other position where it can be turned about from port to starboard. It should be very firmly secured to the deck, and connected with a high-pressure boiler by a three-inch pipe. A straightway valve should be placed in the pipe near the boiler, and means should be taken to prevent accumulation of water in the pipe leading to the apparatus.

If the sea were perfectly clear, the blasts sent out would be recorded at the very instant of their production, but no echo would be returned other than that due to the waves of the sea, which would produce a zigzag line of small amplitude; but if there should happen to be an object of any considerable size at a distance no greater than two or three miles, the zigzag line on the paper would be changed, the amplitude of the waves would be greater and would be very noticeable. To make sure, the blasts could be repeated several times; and then, if the result should be always the same, it would indicate the presence of some object, and the length of paper between the primary blast and the echo would indicate the distance that the object was from the ship. It might be so arranged that one inch of paper represented a mile.

The receiving instruments can be placed anywhere on the ship where they can be turned in the same direction that the siren is turned, and there may be as many of them as desirable.

Of course, there are vastly more accidents caused by running ashore than by collisions at sea, and it does not require a very bold sea front to produce a very strong echo. For example, in approaching the coast of Ireland, the echo would be sufficiently strong to show itself over a distance of at least ten miles.

To many it will doubtless appear very difficult, even on the verge of the impossible, to reveal the presence of objects at sea by simply sending out atmospheric vibrations and receiving the echo of the same. One might ask, how can it be possible to judge of the size, distance, and character of the object by the echo? If, however, we make a careful study of the matter, we shall find, if we send out a powerful blast of sound like a deep musical note, that it will travel a long distance, and if it strikes any object of considerable size, it will send back a reflection or echo. Sound is nothing more nor less than atmospheric vibrations. If there are less than sixteen vibrations in a second of time, they are not audible to our ears; we do not hear them, although we may feel them. They may be of great power and able to travel a long distance, and if they should happen to strike any object they send back an echo which, although completely inaudible to our ears, is sufficient to record itself by suitable apparatus, and the record thus made will give us a fair idea of the object struck. It will indicate its size and shape with a fair degree of accuracy; it will indicate its direction from the ship, and will also show its distance with great accuracy. It will distinguish a ship from an iceberg, will show whether the object is stationary or moving, and if moving, the direction and velocity of such movement.



6.—Apparatus for recording the frequency and amplitude of the atmospheric vibrations. A rod is attached to the center of the diaphragm, which carries a pencil to record the vibrations on paper.

7.—The instruments are placed inside of a large hoop and suspended by eight rubber straps. This effectually prevents them from participating in the vibrations of a high-powered ship.

The Trade-mark as a Business Asset

By W. E. Woodward

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[THE average business man has only the vaguest notion of the value of a trade-mark. He does not realize that it is very often the connecting link between the producer and the ultimate consumer; that it is a symbol of good will, a tangible asset with a determinable money value; that it must be chosen and applied not in a haphazard way but with a due regard for its psychological effect upon the public. Nor does he realize the importance of complying with the statutory requirements which secure to him a property right in a trade-mark comparable with the property right that an inventor acquires by taking out a patent.

The following is the third of a series of articles, written by a man who is at once a trade-mark, an advertising, and a business expert, a man who has a first hand knowledge of the value of trade-marks and of the correct methods of trade-mark exploitation. The series, which will be eventually published in book form, will include discussions, written in business English, of the Federal trade-mark law, analyses of the requirements for registration, the elements of a good trade-mark, and trade-mark protection.—EDITOR.]

The Federal Trade-mark Law.—III.

(Continued from page 62, July 20th, 1912.)

The right to register trade-marks is limited to individuals and corporations.

Under the United States law an association cannot possess a trade-mark, as *exclusive ownership* and *specific origin* are essential attributes of validity.

The letters "A-A. L.," meaning Anti-Adulteration League, were refused registration as a trade-mark for flour on the ground that the mark did not represent origin, but membership in an association. The applicant was a voluntary association of flour manufacturers. It was held that an association cannot be the "owner" of a trade-mark within the meaning of the statute.

Some States have enacted laws prohibiting the unauthorized use of the labels of trade-unions and similar associations. The laws are not trade-mark statutes. They are based on the broader principle of unfair business competition.

It is the general opinion, we believe, of trade-mark authorities that the lack of provision in our law for association trade-marks is a defect that should be remedied as soon as possible. It is a noteworthy fact that most of the other great nations recognize association marks.

An interesting example of an association trade-mark is that of the Irish Industrial Development Association. This association has a membership of about five hundred Irish manufacturers. Its use indicates that the merchandise to which it is affixed is of Irish manufacture; in other words, it is indicative of geographical origin. The Irish trade-mark has been registered in Great Britain under the British Trade-mark Act of 1905.

An American of the name of D. B. Barrett attempted to register this mark in the United States Patent Office under his own name. This fact came to the attention of the Irish Industrial Development Association and some correspondence relating to the matter passed between Mr. John Redmond, the leader of the Irish National party in Parliament, and President Taft. As the law now stands, this Irish trade-mark cannot obtain in the United States the protection that registration might give.

Within the last few years several American communities have adopted trade-marks, or labels.

There is a genuine need for an amendment to the law that would give this class of marks the right of registration.

A provision of the Act of 1905 legalized all trade-marks that had been in exclusive use by the applicant for ten years prior to the passage of the act, and this provision applies even to trade-marks of ten years' standing that, because of their character, could not be registered under

the act. The wording of the act dealing with this subject is as follows:

"Nothing herein shall prevent the registration of any mark used by the applicant or his predecessors, or by those from whom title to the trade-mark is derived, in commerce with foreign nations or among the several States, or with the Indian tribes, which was in actual and exclusive use as a trade-mark of the applicant or his predecessors from whom he derived title for ten years next preceding the passage of this act."

A manufacturer cannot register a trade-mark and file it away with the intention of using it at some future time. A condition of validity is that the mark must not only belong to the applicant, but must be "used by him in lawful trade." An intention to use a mark is not sufficient. The use in trade must antedate the application for registration. The letter of the law is complied with if a single package of the goods with the trade-mark affixed is exposed for sale.

Those who intend to adopt trade-marks should keep in mind that the use of a trade-mark is limited strictly to one class of merchandise, which must be the class for which it has been registered.

An applicant for registration must specify not only the general class of merchandise in connection with which he intends to use his trade-mark, but must state also specifically the articles in that class upon which he has used the trade-mark he seeks to register.

For instance, a manufacturer who might apply for the registration of "Pendennis," as a trade-mark for smoking tobacco—to select a word at random—would find that it would not be satisfactory to the Patent Office to state in his application that the mark was being used in connection with Class 17—"Tobacco Products." He would be required to state that his mark was being used on "smoking tobacco." After registration had been granted the Patent Office would not register another "Pendennis" trade-mark in that class of merchandise to be used on cigars, for instance, for another applicant. Nor would the first registrant be obliged to apply for a new registration if he should desire to extend the use of his trade-mark to cigars, or chewing tobacco, or any other tobacco product. The law would protect him in the use of the mark for all articles of that class, but the rules of the Patent Office require applicants to give full particulars not only as to class of merchandise but the specific articles on which the mark has been used.

A result of the principle of trade-mark practice which limits the use of a mark to one class of merchandise is to be seen in the same name being used as registered mark for unrelated articles.

The name "Pompeian," for instance, is used as a trade-mark for a face cream and also for wire netting for window screens; "Republic" is used for automobile tires as well as several other articles in different classes; "Packard" for pianos and automobiles; and there is an "Ideal" hair-brush and an "Ideal" fountain pen.

The law directs that the owner of a registered trade-mark affix, print or impress upon such trade-mark wherever it is used, or in close enough proximity to it to be easily seen, the words: "Registered in U. S. Patent Office," or the shorter abbreviated form, viz., "Reg. U. S. Patent Off." The trade-mark of Baker's cocoa—the Baker chocolate girl—shows how this should be done.

If this notification is not used in connection with the trade-mark, the owner of the mark, in infringement proceedings against an unauthorized user, cannot collect damages unless he can prove that he gave the other party formal notice, and that the unauthorized use of the mark was continued after the notice.

A trade-mark is not merely an advertising symbol. It is an essential of trade-mark validity that the mark be affixed to the goods. A device, or word, or phrase, or picture that is used only in circulars, advertisements, or on signs or letter-heads is not a trade-mark and cannot be protected under the trade-mark laws. (It should be stated here that the unauthorized use by another than the owner of such a device or wording may sometimes be prosecuted under the common law—the law of unfair business competition.)

A trade-mark may be printed, pasted, written, stamped, stenciled, branded, sewed or woven upon the article with which it is used. In cases where it is not practicable to affix the mark upon the merchandise itself it must be affixed to the container.

RULES OF THE PATENT OFFICE.

We have not the space here to go into a detailed description of the procedure of the Patent Office in considering trade-mark applications. This procedure, especially in cases where there is some doubt as to the validity of the mark, is highly complicated, and can be followed successfully only by an attorney experienced in trade-mark practice.

The rules of the Patent Office require applications for registration of trade-marks to be made in a certain conventional form. A drawing of the mark, of a certain specified size, must be submitted with the application. Proofs of the mark, as actually used, must also be forwarded as exhibits in the case.

If, on preliminary examination, the mark appears to be entitled to registration, a reproduction of it is printed at least once in the *Official Gazette* of the Patent Office. This publication must be at least thirty days prior to the date of registration.

The purpose of the publication of the mark in the *Official Gazette* is to allow opposition from any one who thinks its registration would conflict with his rights. Opposing an application is technically called an "opposition." An opposition serves to delay registration until the examiner in charge of interference considers the evidence submitted.

Under certain conditions, rejected applications may, on appeal, be taken up to the Commissioner of Patents.

The number of rejected applications is very large. Under the law of 1905 the total number of applications up to May, 1912, was 62,500.

The total number of registrations under the law is around 42,000. This means that more than 20,000 applications have been rejected in seven years. In other words, about two out of every three applications pass the gauntlet of Patent Office scrutiny, interference and opposition, and are registered.

Many of the defective applications fail because of a lack of competent advice in devising the proposed trade-marks, as well as because of inexperience in prosecuting the applications.

(To be continued.)

Notes for Inventors

Wanted: A Collar Fastening Improvement.—Have you ever tugged at the tab of one of the modern high turn-down collars and fretted yourself into a perspiration before finally getting it fastened? If so, you will realize there is a field for an improvement either in the collar itself to make the fastening easier, or in the collar button, or a substitute for such button which will enable the convenient fastening of the collar and securely hold it when once fastened. Attempts have been made by at least one collar-maker to obviate the necessity of buttoning a collar.

A Device That Loads and Unloads Motor Trucks.—There is considerable activity at the present time in devices for loading and unloading motor trucks through the aid of removable bodies which may be loaded and then applied to the truck. Ralph L. Morgan of Worcester, Mass., has secured a patent, No. 1,030,320, for a motor truck apparatus in which the bed of the truck inclines or curves downwardly at one end so it may readily adjust under a body suitably supported at the desired elevation and a platform is provided having a slip for supporting the crate or body, the slip being so formed that the truck may be run into it and the bed of the truck being slightly higher than the top of the slip so that the truck with the crate upon it may be run into the slip and the crate will be supported on the truck over the slip. Then when the crate or body is fastened at its rear end by a chain or the like, the truck may run out below the crate and the latter be left upon the slip.

Women Inventors.—Voltaire wrote that there are learned women just as there are women warriors; but they are seldom or never inventors. It is not clear whether he intended to exclude from the class of inventors, women generally or only "very learned" women. Certainly women have invented in many fields and it is not seen how learning can decrease their ability in such direction, for another writer tells us that invention is activity of mind and is a sharpening of the spiritual sight, to discern hidden aptitudes. Certainly this spiritual sight should not be dimmed by learning.

Legal Notes

A Trade-mark Ruling.—In the case of Burton Medicine Company v. United Drug Company, Assistant Commissioner Tennant has held that where an opposition to the registration of a trademark is filed by a registrant, a cross bill asking for the cancellation of the opposer's registration will not be admitted.

The Case of a Foreign Trade-mark Applicant.—In the trade-mark case of Ross & Brothers v. The Louis Bergdoll Company v. The Greenway Brewing Company, Assistant-Commissioner Billings has held:

"Where a foreigner applies for registration for a trade-mark subsequent to the registration by a citizen of this country of the same mark, that in order to be entitled to an interference with such registration the foreign applicant must make a *prima facie* showing of use in this country."

A Welsbach Incandescent Filament Decision.—The Court of Appeals of the District of Columbia has affirmed the decision of the Commissioner of Patents holding certain claims in a Welsbach application unpatentable in view of the prior art. The filament presented in the application comprised a stable electrically conducting mixture of osmium and one of the described oxides, and the Court, in affirming the decision of the Commissioner, said that other references to prior patents were given, but it thought that the Edison patent furnished a complete anticipation of the claims involved.

The Supreme Court and Improvements.—History shows that the Supreme Court has followed invention and improvements even in its decisions of constitutional questions. While telegraphy was unknown at the time the Constitution was written and the word itself was not in existence, the Supreme Court brought the term word within the meaning or within the scope of "commerce" as used in the Constitution and Chief Justice Waite thus explained the extension of the power:

"The powers thus granted are not confined to the instrumentalities of commerce . . . known or in use when the Constitution was adopted, but they keep pace with the progress of the country, and adapt themselves to the new developments of time and circumstances. They extend from the horse with its rider to the stage coach, from the sailing vessel to the steamboat, from the coach and the steamboat to the railroad, and from the railroad to the telegraph, as these agencies are successively brought into use to meet the demands of increasing population and wealth."

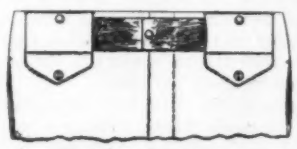
Delay of Application After Reduction to Practice.—In Walker v. Lederer, Mr. Commissioner Moore has decided that "Where W. reduced the invention to practice prior to the earliest date of invention claimed by L., that W. did not forfeit his right to a patent in favor of L. by delay in filing his application where there was no suppression or concealment of the invention." In the course of his decision, the Commissioner says that no case has been cited and he knew of none where a patent had been refused or held invalid solely on the ground of delay in filing the application for patent after a reduction to practice by the inventor and he distinguished from cases where abandonment either intentional or constructive had been established.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

BELT.—T. HERSHKOWITZ, 944 Union Ave., Bronx, N. Y., N. Y. This invention provides a resilient belt for trousers mounted upon the waist-band thereof to maintain an approximately constant pressure on the person of the wearer while expanding to accommodate the movement of the person; provides resilient



BELT FOR TROUSERS.

means for the belt to increase the period of its service; and provides guide members for the belt, said members being attached to the trousers. The advantage in the use of the belt is that the waistband of the garment is held in its correct position upon the wearer's body under all normal conditions. The engraving shows a front view of a fragment of trousers provided with a belt and pocket structure.

Pertaining to Aviation.

AERIAL PROPELLER.—H. L. ELLIOTT, 222 P. O. Building, Kansas City, Mo. The invention is an improvement in so-called screw propellers whose blades are rotatable on their axes in order that they may be set at different transverse angles relative to the plane of rotation of the propeller as a whole, whereby the pitch or lead of the blades may be varied to effect propulsion at different angles.

STABILITY DEVICE.—F. NYILAS, 130 W. 52d St., Manhattan, N. Y., N. Y. This device is more particularly adapted to be applied to aeroplanes. The invention lowers the center of gravity below the center of buoyancy of the floating body. It maintains center of gravity in stationary position with reference to center of buoyancy, irrespective of any force which might tend to change this relation. It will lower the center of gravity during flight and means provide that the device may be moved up parallel with the aeroplane during landing, to economize storage space.

Of General Interest.

PROPELLER.—A. CARDOSA DE LOS RIOS, care of La Alemana Lamparena Electrica, Monte 211 Havana, Cuba. This invention relates more particularly to a propeller comprising an elongated, tapered hub, and an elongated, tapered screw blade, of varying radius, for purposes of propulsion in connection with marine vessels, aeroplanes, etc., which provides means by which negative slip may be minimized.

CIGAR BOX.—J. J. PLANCO, care of Ruy Suare & Co., 422 E. 53d St., Manhattan, N. Y. This invention relates to a cigar box, and the object is to provide a cigar box in which cigars of peculiar configuration may be packed in position separate from one another so as to prevent injury to the same. Means provide that the cigars are so arranged that they may be readily withdrawn.

Hardware and Tools.

MAGAZINE HAMMER.—O. J. A. SMITH, Piedmont, Mo. The purpose of this invention is to provide an improved hammer which is simple and durable in construction, easily manipulated with one hand and arranged for quickly discharging nails, tacks or like fast-

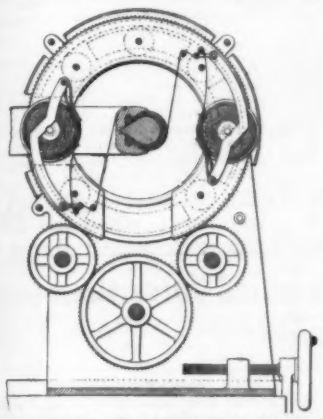
MAGAZINE HAMMER.

eners one by one, for setting the discharged fastener at the desired place on the object into which the fastener is to be driven, and allowing driving the fastener home without requiring the operator to touch or handle the fastener, and leaving one hand free for manipulating the object. The engraving shows a sectional side elevation of the hammer. The inventor's address is care of C. W. Chandler, Greenville, Mo.

ROUTER PLANE.—B. AYLOR, 1212 E. 105th St., Cleveland, Ohio. This invention provides a router plane stock with supplemental cutters and routers, the same being placed opposite one another in vertical position and adapted for lateral adjustment as required to cut grooves of different widths. These attachments are located in front of the ordinary router bit, which may be then used to cut and clean out the wood between smaller grooves made by the two attachments when adjusted greater or less distance apart.

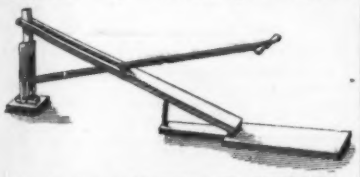
WIRE STRETCHER.—J. L. ASHWORTH, Thompson Station, Tenn. An object here is to provide a device which may be used as a boomer or a woven wire or a barb-wire stretcher, and which while effectually accomplishing the purpose for which it is intended is simple, and is, therefore, not liable to get out of order.

TIRE WRAPPING AND UNWRAPPING MACHINE.—J. W. THROPP, care of W. R. Thropp, E. State St., Trenton, N. J. The driving mechanism operates to rotate the tire about its axis at even rate of speed, to secure even winding; a pressure for tire and containing molds is arranged to be imposed on the tire and molds by the driving mechanism, to avoid any friction due to tire movement; driving mechanism for the shuttle provides for avoiding the need of a filler for gap in the shuttle; a shuttle carries a plurality of bobbins and takes wrapper supply therefor; means provide for removing or renewing the bobbins and supply for the shuttle; also for controlling the speed of the machine, to increase, diminish or reverse the operation thereof, and means to unwind wrappers from the tire and reverse direction of the wrapping. The engraving shows a vertical section of the invention.



TIRE WRAPPING AND UNWRAPPING MACHINE.

APPARATUS FOR SCRUBBING AND POLISHING FLOORS.—F. A. MCKAY, care of Manton & Hart, Kingston, Jamaica, W. I. Scrubbing and polishing may be quickly accomplished without the necessity of the operator kneeling or stooping, and effective polishing pressure may be exerted upon the polishing brush, during its manipulation by the operator. As shown in the accompanying engraving the platform rests upon the floor. The rib being in direct contact with the floor, the operator places his right foot thereon, grasps the handle bar and moves the operating lever back and forth, as shown in dotted lines, thus imparting reciprocating movement to the brush. The device may be moved from right to left as desired to change the point of operation of the brush.



DEVICE FOR SCRUBBING AND POLISHING FLOORS.

Prime Movers and Their Accessories.

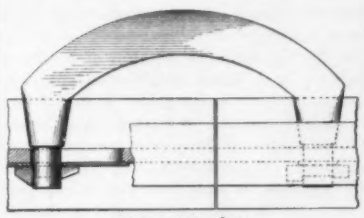
ATTACHMENT FOR OIL WELL APPARATUS.—J. W. LEONARD and H. E. BROWN, care of G. L. Roberts, 215 Water St., Pittsburgh, Pa. This invention relates to clutches to be applied to machinery adapted to be driven by internal combustion engines. The apparatus may be quickly adjusted to the shaft of a steam engine, the cylinder of which has been replaced by one of the internal combustion type, with the bearing of the extended shaft on which the clutch is mounted, held in rigid relationship to the engine cylinder on a pivoted support to prevent fracture of shaft by the working of the engine on its bed, relatively to the bearing.

Railways and Their Accessories.

TRAIN STOPPING MECHANISM FOR BLOCK SIGNALING SYSTEMS.—M. CONRAD, 114 E. Maumee St., Adrian, Mich. This device is for use on trains whose movements are controlled by electric block signaling systems. An object of the invention is to provide means by which the on-coming train may be automatically stopped if the block is not clear.

BLOCK SIGNALING SYSTEM AND SAFETY APPARATUS.—M. CONRAD, 114 E. Maumee St., Adrian, Mich. This invention relates to block signaling systems adapted for use on steam or electric roads and designed to be entirely automatic in operation for preventing head-on or rear-end collisions on single track lines or accidents at crossings and switches, thus dispensing with the usual telegraph and block offices with their operators and signal men and dispensing also with the train dispatcher.

FLOAT RAIL LOCK.—G. W. CLEMMONS, 82 Bloomfield St., Hoboken, N. J. This invention relates to a means for locking a car float to a floating bridge. It provides a lock which will maintain the tracks on the float and the tracks on the bridge in alignment, but will, at the same time, permit a slight play between float and bridge. The lock may be readily affixed to the rails on bridge or wharf and quickly attached to the rails on a car float. These objects are attained by pivoting a yoke to a rail or bridge or wharf, which yoke has its free opposite end adapted to engage an elongated slot in a correspondingly aligned rail on the float. The engraving shows a plan view looking down upon adjacent meeting ends of contacting rails.



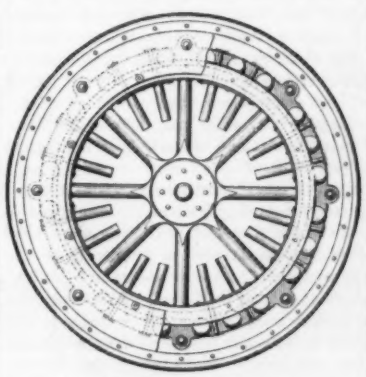
FLOAT RAIL LOCK.

Pertaining to Recreation.

WATER CAROUSEL.—A. C. BAIL, 436 E. 138th St., Bronx, N. Y. More particularly this invention involves an amusement device made up of a suitable basin in which a number of receptacles, such as tubs, are suitably positioned, means being provided whereby these receptacles may be moved around the basin, a turning movement being imparted to them at the same time.

Pertaining to Vehicles.

VEHICLE WHEEL.—W. W. REVELL, St. Andrews, Walden, N. Y. This wheel has a rigid tire and the center structure is supported by interposed resilient members. The resilient members are constructed and arranged in unit form to avoid complete deflation of the cushion element. The tire and body portion of the wheel are connected in such manner as to permit a certain degree of independent action of the tire and body portion, and to correctly limit the same. The tire construction prevents skidding. The invention provides a tire constructed from relatively thin strips of non-resilient material having disposed therein rings constructed of suitable wire fabric. A side view of the wheel is illustrated herewith.



VEHICLE WHEEL.

WHEEL CONSTRUCTION.—H. W. SANFORD, care of Sanford Iron Works, Knoxville, Tenn. The object here is the provision of means for preventing wear on the hub and bearing sleeve of wheel mountings, wherein the wheel is journaled on the axle. All end thrust of the wheel pushing inwardly is received by the interchangeable blocks or washers at the center of the axle, thus reducing wear and friction to a minimum.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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(12662) G. L. M. asks: A friend of mine claims that the recoil of a gun does not commence until after the projectile has left the muzzle of the gun, admitting that if the gun were to be infinitely long, there would be no recoil. Is this true? A. The recoil of a gun begins when the bullet begins to move in the gun. Newton's "Third Law of Motion" is applicable to this case: "To every action there is an equal and opposite reaction." There can be no motion of the gun backward till the bullet begins to move in the opposite direction. There is another way to look at it. If the charge of powder were exploded in a chamber strong enough to hold the pressure of the gases, there would be no motion produced by the powder, and no motion of the chamber in any direction. The recoil is due to the fact that the gun has the same quantity of motion backward that the bullet has forward. If the bullet had the same weight as the gun, the gun would move backward with the same velocity as the bullet moves forward, and would strike the same blow as the bullet. It is the motion of the bullet which produces the recoil of the gun. The force of the powder acts in the same manner in every direction. The sides of the gun barrel resist this pressure and prevent motion sidewise. The bullet, if it does not stick, moves. The pressure of the gases is the same forward and backward, and this force is applied to the bullet forward and to the gun backward. Each has the same quantity of motion, or momentum, as it is termed.

(12663) J. H. I. writes: I have heard that copper or zinc filings thrown in a fire will reduce the soot in stove and chimney to a fine white powder, obviating necessity of cleaning. A preparation to accomplish this result was once on the market. I shall be glad if you can inform me if you know of the preparation. A. Two receipts for chimney cleaners are given in "Scientific American Cyclopedia of Formulas." First, make a hot fire, then put the compound in the blaze and put up a blower or close the stove door, so that the gases evolved will rush up the chimney. No. 1. Parts by weight. Copper sulphate 7, coarse salt 6, ammonium chloride 8, saltpeter 5, fine sand 2, coke dust 2. Mix well. No. 2. Chloride of sodium 7, potassium nitrate 4, cuprous sulphate 7, muriate of ammonia 8, flour of sulphur, small quantity. The "Scientific American Cyclopedia of Formulas" contains thousands of useful formulas and processes, and will be found very valuable. It is sent, carriage paid, for $5.

(12664) I. N. V. asks: What is a jet propeller and what experiments have there been made in that line? A. Jet propulsion is a method of propelling a boat by pumping in a stream of water at the bow and driving it out at the stern below the water line. The reaction of the water outside against the jet causes the boat to move forward. Many efforts have been made to produce a successful result, but all have been failures, returning but a small per cent of the power expended. We have published the accounts of these experiments as they have been made in the past, and can send you eleven papers upon the subject for ten cents each. You will also find valuable material in Kent's "Engineers' Pocket Book," which we will send for $5.

(12665) J. F. McG. writes: In the issue of June 1st of the SCIENTIFIC AMERICAN appears a question by W. O. E. (No. 12643) about the duration of life of toads and frogs in rock. By your reply, it would seem you place no credence in the idea of these creatures having a long life, almost indefinite, under certain conditions. Permit me to supplement W. O. E.'s question by relating what I was an eye witness to, viz., a toad being taken out of rock and still alive. This district is a limestone region, the layers of rock running from an inch to eight inches in thickness, and along the river valley this rock is right at the surface, blasting being necessary from the start in any excavation work. Now a well was blasted out in this vicinity, and during the process, when at a depth of fourteen or fifteen feet, a small cavity was disclosed in which was a fair-sized toad. Mr. Toad was put on top of the bucket and hoisted to the surface, and to all appearances was dead. He was tossed out into the sun; but strange to say, his dormant condition began to disappear, and it was not many minutes before Mr. Toad was hopping around like any other one of his kind, the only difference being he did not exhibit ordinary toad intelligence, as evidenced by his lack of judgment when he hopped plumb into a batch of fresh slaking lime. He was fished out with a hoe, but whether he survived this treatment or not, I do not pretend to know; but the fact remains he came out of a rock hole at a fair depth, and the question is, how did he get into such a place, and how long had life been existing in him?

NEW BOOKS, ETC.

FORNEY'S CATECHISM OF THE LOCOMOTIVE. Third Edition. Revised and enlarged by George L. Fowler, Associate Editor *Railway Age Gazette*. New York: The Simmons-Boardman Publishing Company, 1912. Distributed by the McGraw-Hill Book Company, 239 West 39th Street, New York. 2 vols. 6 in. by 9 in. Price, $5; sold separately per vol. $3.

Books, like individuals, have their histories, and Forney's "Catechism of the Locomotive" practically originated in a translation of Kosak's "Katechismus der Einrichtung und des Betriebes der Locomotiv," which the editors of the *Railroad Gazette* had made, intending to re-publish it in their journal. This translation was submitted to Mr. Forney for revision and adaptation, but he found that the scope of Kosak's work was too limited for American practice and requirements, so that while retaining the "idea" of a Catechism and following the general plan of Kosak's work, he so far extended and enlarged upon it as to make it substantially a new and original book. The late Mr. M. N. Forney was one of the highest authorities in locomotive engineering, and those of us who had the privilege of knowing him will remember not only the remarkable depth of his information, but his rare ability to clothe his ideas in concise, clear and simple language, making his meaning "plain to plain people." These endowments enabled him to write a book, the object of which was "to furnish a clear and easily understood description of the principles, construction and operation of the locomotive engine of the present day, a subject which is not concisely or adequately treated in any one similar book." This work was published in 1873, and it was the best known and most widely studied book on the subject in this or any other country. It was afterward revised by Mr. Forney, and a second edition was published in 1889. Since then the locomotive has undergone great changes, not only in size but in construction and operation, and a third edition of the book became necessary. This work was intrusted to Mr. George L. Fowler, an eminent engineering authority, who was a friend of Mr. Forney, and who had been asked by the latter to undertake the revision, with the result that we have in the present edition by far the most complete presentation of the subject that has appeared, and one which will not only be indispensable to all who are engaged in the management, construction and working of locomotive engines, but a most useful book to a large class of readers and students in this country and in Great Britain who, while they are not connected with railways, have a deep admiration for the locomotive—the most interesting form of the steam engine. In preparing the new edition, it was found that the great increase in size and complexity of the locomotive engine necessitated the introduction of much new matter, such as the system of compounding, the introduction of the Mallet engine, the superheater, the Walschaerts valve gear, the mechanical stoker, and recent extensive improvements in the air brake system, as well as other details. It was, therefore, decided to break the book into two volumes, making each complete in itself. The first volume deals with the practical construction and operation of the locomotive in a way to make it intelligible to men who have not had the advantage of a technical training. There are 743 questions with their answers, 644 pages and 475 illustrations, to which are added six folding plates of locomotives, valve gears and air brakes. The colored diagrams showing the construction and operation of the Westinghouse air brake and of the Stephenson and Walschaerts valve gears are admirably full and clear. The second volume discusses the same points more theoretically, but always in simple language devoid as far as possible of mathematical calculations, and shows why locomotives are built as they are and the principles of their operation. This volume comprises 375 questions, with their answers, 293 pages and 199 illustrations. The letterpress and engravings are all excellent, and last but not least, each volume has a full and carefully prepared index by which the reader can readily refer to any particular topic in the book

UNITY IN NATURE. An Analogy Between Music and Life. By C. E. Stromeyer, M.I.C.E. London and Manchester: Sherratt & Hughes, 1911.

It would be difficult to find a book at once so metaphysical and yet so practical. An engineer by training and experience, it is to be expected that Mr. Stromeyer is not in sympathy with some of our modern scientific ideas. He does not like our current conceptions of the ether, for example, and substitutes a theory according to which space is filled with a thin gas. So, too, we find him dissatisfied with current conceptions of energy. He still adheres to the old definition of energy as a product of force into distance. Nowadays the principle of action and reaction is more strictly adhered to. Most excellent reading is to be found in the essay on "Science and Soul of Music." This is indeed a splendid piece of illuminating writing. Perhaps the most amazing characteristic of the book is its diversity of subject matter. It would hardly be expected even in a book on the unity in nature to find essays on "Flatland," "The Essence of Music and Life," "The Fourth Dimension," "Geological Records," "State Incongruities," "Urbanism," and "Ruralism." Yet the author has woven them together in a most ingenious fashion.

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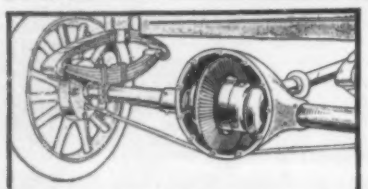

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The Why and Wherefore of the Muffler and Cut-out

By Harold Whiting Slauson

ENGINEERS have been laboring for years to produce the silent car. Months of constant experiment have been spent in efforts to evolve a quiet transmission or forward train of gears, and only by the use of special bearings and accuracy and detail to the thousandth part of an inch have the results as exemplified in the modern automobile been obtained.

But of course the noisiest part of a car is the motor, and anyone who has attended a road or a track race will bear witness to the fact that the power plant announces its importance in no uncertain terms when its exhaust is unrestrained by a muffler. And for good reason does an unmuffled and healthy motor make itself heard, for it is a tremendous power that is harnessed in the cylinders and made to expend its energy in forcing down the pistons. Each explosion in each cylinder generates a pressure approximating 250 pounds on each square inch of piston surface. This means that, in a 50 horse-power, four-cylinder motor, a force of nearly three tons is concentrated on each piston with every ignition of the charge in that particular cylinder. Or, if we consider the gas engine as a whole, a total of over 5,000 tons is exerted on the pistons each minute that the motor runs at normal speed.

These are imposing figures, and it may be wondered why such a gasoline motor develops *only* 50 horse-power, but it must be remembered that this force is not applied continuously but that it is divided into a number of three-ton "hammer blows" of short duration. After the first "impact" the pressure decreases until, at the end of the stroke, it is scarcely sufficient to overcome the friction of the motor. But though the three-ton energy of each explosion is soon expended, there is still a considerable force, amounting to three or four times the pressure of the atmosphere, that must be disposed of at the bottom of the stroke. This is the exhaust, and when this pressure is suddenly turned loose into the open air by the quick motion of a valve, a sharp report is bound to occur; for the force in question is really the "tail end" of the explosion that has but just taken place in the cylinder. Let two thousand of these "tail ends"—each of which is pretty vigorous by itself—occur in a minute, and it will be realized why "ear-splitting" is a mild term to apply to the unmuffled exhaust.

Now to many of us, the term "muffle" may convey the idea of to choke, or cover up, and this, in a sense, is what the muffler does to the noise of the explosion. But the muffler does not throttle the exhaust with a high hand and say, "You shall not escape," but rather does it lead the gas to expend its energy by easy stages. It does this by providing a chamber in which the exhaust gas may be expanded before reaching the outside air. If the exhaust were carried through a series of expansion chambers, it would have become quite meek and subdued by the time it was discharged, for as it expands, so its energy—and consequent noise-making ability—is expended. But in order to save space and weight, many mufflers are in the form of a single expansion chamber provided with a series of "baffle plates," or disks, containing a number of perforations through which the gas passes, and thus the exhaust expends most of its energy in these and is rendered practically harmless by the time it has reached the place where it could make any impression on the human ear.

Many motorists consider the word "muffler" to be synonymous with "back-pressure," and as they know that this latter term means a resistance to the passage of the exhaust gases and a consequent reduction in the power developed by the motor, some of them have come to look upon the muffler as a power-absorbing device. In consequence of this belief, the cut-out, by which the exhaust gases are allowed to escape directly into the open air without first passing through the muffler, has become one of the most used—and abused—accessories of the car. Its *abuse* has become so flagrant, in fact, that many cities and towns have enacted ordinances prohibiting its *use*, and it is looked upon as the one device that is setting at naught the efforts of the designers and builders toward the production of the silent car.

It may be that the old type of muffler, provided with many obstructions to the passage of the exhaust gases, produced an appreciable amount of back-pressure that absorbed some of the power developed by the motor. The power plant of the modern car, however, is equipped with a muffler of a type that, by means of especially-shaped passages and expansion chambers, enables the speed of the out-rushing gas to be increased so that the resistance of the muffler may be nearly overcome and the amount of back pressure will be reduced to very small figures. In fact, tests that have recently been made on several motors when run both with and without the muffler in place have shown some surprising results. These tests demonstrated that, for all practical purposes, the muffler produced no diminution in the power developed by the motor at slow and medium speeds. On the contrary, some of the tests showed that the motor produced slightly more power at 700 and 800 revolutions per minute with the muffler in place than was the case when this "noise reducer" was removed. At speeds of 900 and 1,000 revolutions per minute there was but little difference noticeable; but at speeds at which the motor began to deliver its maximum power, a slight loss could be detected with the muffler in place. At 1,400 or 1,500 revolutions per minute this power loss amounted to slightly over five per cent of the total energy delivered to the dynamometer without the muffler in place.

The mufflers used in these tests showed back-pressures varying from zero to three and five pounds per square inch. Consequently it is possible that an old muffler, of poor design and clogged with soot and carbon, may absorb slightly over ten per cent of the maximum power of the motor. But the interesting feature of these experiments lies in the fact that they show the power loss caused by the muffler to occur *only* when the motor is operating at high speeds and delivering its maximum energy. But even the smallest car is capable of attaining speeds well over thirty miles an hour, and it is evident that the full power capacity of the motor should never be required in cities or towns. Consequently, it is only in the open country in which the maximum speed can be attained, or in the ascent of a steep hill in which the full power of the motor is required, that the cut-out is of any advantage in reducing the back-pressure offered to the exhaust. And even in these instances, the advantage gained by the elimination of the muffler is problematical, and is more theoretical than practical. The sound of the unmuffled exhausts at the rear of the car gives the impression of increased power, but the effect is more hypnotic than actual and it is quite possible that the car could climb that hill or attain the same speed on that straightaway as easily with the motor operating quietly as it could with the explosions making themselves evident in a stream of Gatling-gun reports trailing behind the machine.

But granting that a steep hill can be climbed faster or a higher speed on the level can be attained with the muffler cut out, what are we to think of those drivers of the high-powered cars who open the cut-out without provocation when driving through the city at a pace which could not possibly require more than a third of the power capacity of the motor? It can only be the desire to attract attention that prompts such a procedure, for the slightest movement of the throttle or spark lever will produce more power than would the most strenuous pressure on the cut-out button.

But because the cut-out has been abused is no indication that it does not possess value when properly restricted. It may be made to serve as an effective warning signal for the average pedestrian will "move" more quickly at the sound of the

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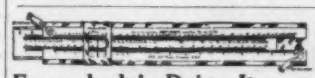

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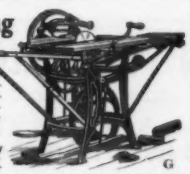

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short, sharp barks of the unmuffled exhaust than he will at the more musical notes of the horn. Then, too, it is the very absence of noise attendant upon the operation of the modern motor that makes it difficult to distinguish the nature of the explosions and to determine in what manner the charge is ignited in each of the cylinders. It is when it is desired to test the motor in the privacy of the garage or the country roadside that the value of the cut-out will be appreciated by the automobilist. A pressure on the button, and the explosions become distinct and any irregular firing of the cylinders can be detected instantly. Then, by turning off the ignition current from various cylinders in succession and by pursuing a process of elimination, the quality of the explosions in each can be detected and simple clues furnished for tracing any trouble to its source.

The cut-out may also be useful for preventing the occurrence of the annoying and startling muffler explosions. If the motor is turned over when the ignition current is switched off, the unexploded mixture from the cylinders will be discharged into the muffler. This will occur if the current is turned off when the motor is running at a high speed, and also when the machine is cranked preparatory to switching on the ignition current. The explosive charges that have filled the muffler will remain there until they are reached by the hot exhaust gases discharged from the motor when it runs under its own power.

These hot gases will ignite the charge in the muffler, and the violent explosions—which will at least startle bystanders, if they do not wreck the muffler—will result. If the cut-out had been opened whenever the motor was turned with the ignition current "dead," these explosive gases would have been discharged into the open air, and no muffler explosion could result when the cut-out was again closed.

The dividing line between the use and abuse of the muffler cut-out is not difficult to draw by those who have at heart the reputation of the motor car. It does seem to be difficult, however, to induce many drivers to follow that dividing line, and as "the sins of the few must be borne by the many," the present sweeping prohibitory legislation has resulted. When every driver has passed that stage in which he resembles a child with a new toy that he likes to "show off," the muffler cut-out will be a safe and valuable accessory for all motor cars. In its present status, however, the disadvantages arising from its abuse so outweigh the minor advantages that its proper use possesses, that many of even the most enthusiastic automobilists are heartily in favor of laws such as those recently passed in New York and other progressive cities.

"Heart Stopping"

(Concluded from page 72.)

To prove this, he proposes to be placed in a box, a foot of sand covering the bottom. His mouth, nostrils and ears will be filled with cotton wool and his eyes bandaged, to prevent the sand from entering his system. Then sand will be piled upon him until he is covered by at least eighteen inches of it, weighing a ton; after remaining in this position for a quarter of an hour he will be extracted alive and well. All of which reminds one of Stevenson's "Master of Ballantrae."

This athlete, interesting as he is from more than one viewpoint, got his idea of stopping his heart by reading of East Indian "fakirs." The press agent concludes with the pleasant assurance that here is another "wonder of the world."

I should like to set down certain observations regarding this phenomenon, which word I use advisedly as meaning "appearance," a term not necessarily consonant with "reality."

It is wrong to state that such muscle manipulation as that described has never before been deemed possible in medical history. Sandow, for example, in his exhibitions was able to make his muscles shimmer most amazingly in the limelight.

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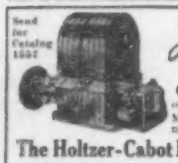

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If anyone is at a loss for an ambition in life, he may by persistent concentration and practice, so manipulate his great toe (or for that matter any other part of his body) as to increase its size out of all normal proportion. Johannes Müller, in 1838, stated (and this is sound psychology to-day) that "The idea of a particular motion determines a current of nervous action toward the necessary muscles, and gives rise to the motion."

Next, as to the photograph demonstrating the decided concavity of the abdominal wall. Of course the abdominal muscles are here contracted and not the stomach. Protrusion of the abdomen is possible, through exercise of the mind. The literature of the *outré* in medicine contains such instances. In medical practice physicians sometimes meet women who have "phantom tumors" of the abdomen. But these phantom tumors disappear when the patient is made to comprehend that she is mistaken, or should the obsession persist, these "tumors" are dissipated, and the abdomen returns to normal, under anesthesia. There are many performers who can remain under water several minutes. "Odiva," it is claimed, can do this at least four minutes, which is not miraculous, but only mildly unusual. As to being buried alive for fifteen minutes, I can only repeat here that I have seen a record of the promise of such feat, but not of its fulfilment.

Statements of wonders done in the East make most entrancing romance; but they can have no standing in the court of science.

And now about that "heart-stopping." The muscles of the body are voluntary and involuntary; the former are mainly under the control of the brain and spinal cord; the latter mainly under the control of the sympathetic system. But not altogether in either case. For generally some cerebro-spinal filaments will find their way into sympathetic ganglia; and *vice versa*.

Many voluntary movements become also involuntary; I will to take a walk; but as soon as I have got started my legs do this for me involuntarily while my mind is occupied with other things. The heart is enervated from both the cerebro-spinal system (the vagus nerve) and the sympathetic system. The normal heart beat is 72 per minute; a patient fearing he has a fatal disease enters the consultation room with a pulse of 130; having been assured there is no such malady, or any occasion for such fear, his pulse beat, on leaving, has returned to normal. Drugs, again, such as mustarin and opium, will very decidedly slow the heart beat.

It seems possible then, by concentrating the will upon the heart, to quicken or slow its pulsations. But I know of no case where the function of the heart can thus be really stopped; and certainly I do not believe the idea will hold in medical science, that this can be done for twenty seconds.

The alleged proof in the case before us appears to be based upon the physician having put his ear to the athlete's chest and listening for twenty seconds, watch in hand, with the result that he heard no beat. We need not question either the athlete's or the physician's good faith. But such failure to hear the heart beat does not prove there is no beating heart. The stethoscope is much more accurate than the unaided ear, and the phenendoscope still more so; the sphygmometer applied to the wrist might trace a pulse beat (which would certainly indicate a heart beat), though no beat could be elicited over the heart. I do not learn that such instruments were used. And even if, by means of the most delicate apparatus, the heart pulsation could not be appreciated, this would still not necessarily argue an absolutely non-functionating heart. Patients are moribund, comatose, for hours, with no appreciable heart beat, and yet they survive; in all that time there must have been some degree of cardiac action.

And if there were absolutely no heart beat, what would become of the blood? It cannot enter the arteries, because it has to be pumped by the heart into the arteries. It would be dammed back upon the lungs with inevitable asphyxia, and there would have to be engorged veins. But of these things no evidence whatever is vouchsafed us.

Hurrying Nature

(Concluded from page 79.)

whether success or failure has crowned his efforts. Then, possibly, he finds that one plant in a hundred has yielded something that is promising. In such crosses there is great divergence of type. It is only by selecting certain individuals in which the types desired exist and seeking to accentuate these types, that a given fruit may be built up and established. Likewise it requires many generations to get the desired characteristics fixed in a given plant. Under the old system the time so consumed was such that seven years were required in establishing a new fruit. In the citrange two plant generations have been grown under the old system. The fruit that has been developed will grow anywhere in the Southern States. It takes on the nature of an improved lemon. It will be more nearly a substitute for a lemon than any other of the fruits that we now have. It is still an ornamental plant and the Department of Agriculture recommends that people living in the Southern States plant the citrange in their yards as ornamental plants and derive the added advantage of being able to pick ripe fruit for citrangade, or for any of the purposes for which lemons are used, from their own gardens at almost any time of the year. There are ten thousand people now growing the citrange trees.

But had the inarch and the nurse tree been in use the citrange would have been passed through eight generations instead of two by this time. The fruit would have been much more highly developed. Many fold greater results would have been already accomplished.

But with the citrange developed as at present and the inarch discovered, there seems great opportunity in this fruit in the near future. The citrange is but typical of a great number of new fruits that are just now being developed. There is the tangelo, which is a cross between the tangerine and the pomelo or grapefruit. The grapefruit is over bitter for many people and its skin is close fitting, making the meat hard to get at. The tangerine is over sweet and the kid-glove skin almost falls from it. It is easy to imagine the fruit that would result from this cross. By selection and combinations of the desired qualities by cross breeding the specimens, the scientists believe that they will be able to establish fruit that will have just the right amount of tartness and just the desired kind of skin. Already there are some specimens of the tangelo growing in Florida that are said to be in every way superior to the orange. With the use of the nurse plant and the inarch great things are expected in the next few years.

There is another application of the inarch that is just now being tested. Delicate fruits such as the lemon that refuse to grow except in a few spots in the very warmest of the United States, are being inarched upon such cold resistant plants as the mock orange. It is known that it

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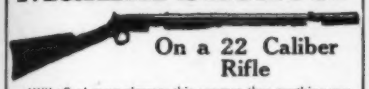

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is the sap control of plants that protects them from frost. The lemon, for instance, keeps its leaves full of sap throughout the winter. When the weather gets sufficiently cold this sap is turned into ice and the plant is as a consequence killed. But where the lemon is inarched on the mock orange, which by nature has a sap control adapted to cold climates, the story is different. When cold weather approaches the mock orange roots refuse to send the sap into the top of the tree. It, therefore, fails to freeze and is not killed by the cold. So it is hoped that by inarching the orange, the grapefruit, the lemon, or any other of the citrus fruits upon the sturdier, related growths farther north, the danger line may be crowded into materially higher latitudes, and that even the citrus fruits of the present may be grown in a vastly wider range in the United States.

The inarch may also be extensively used in rose culture. When scientific plant growers develop a hybrid rose through this same method of cross fertilization they have been forced to wait for years until it came into flower. Some of the most delicate blossoms grow on stalks that are also delicate and slow to develop. Such seedlings may be inarched on the stalk of some sturdy and well rooted rosebush and vigorously crowded into blossom. Its virtues or lack of them may be sooner determined.

There are those who may say that practically the same things may be accomplished by the old process of budding or grafting. This is, however, not the case. Before a plant may be budded onto another stalk it must have acquired considerable age in order to produce the right sort of buds. The process of budding is most delicate and the results are in question. It is vastly slower than the inarch. It is vastly more difficult. The Government plant growers state that any intelligent man, though entirely inexperienced, can readily accomplish the inarch, while the baffling process of budding requires the most exact scientific skill.

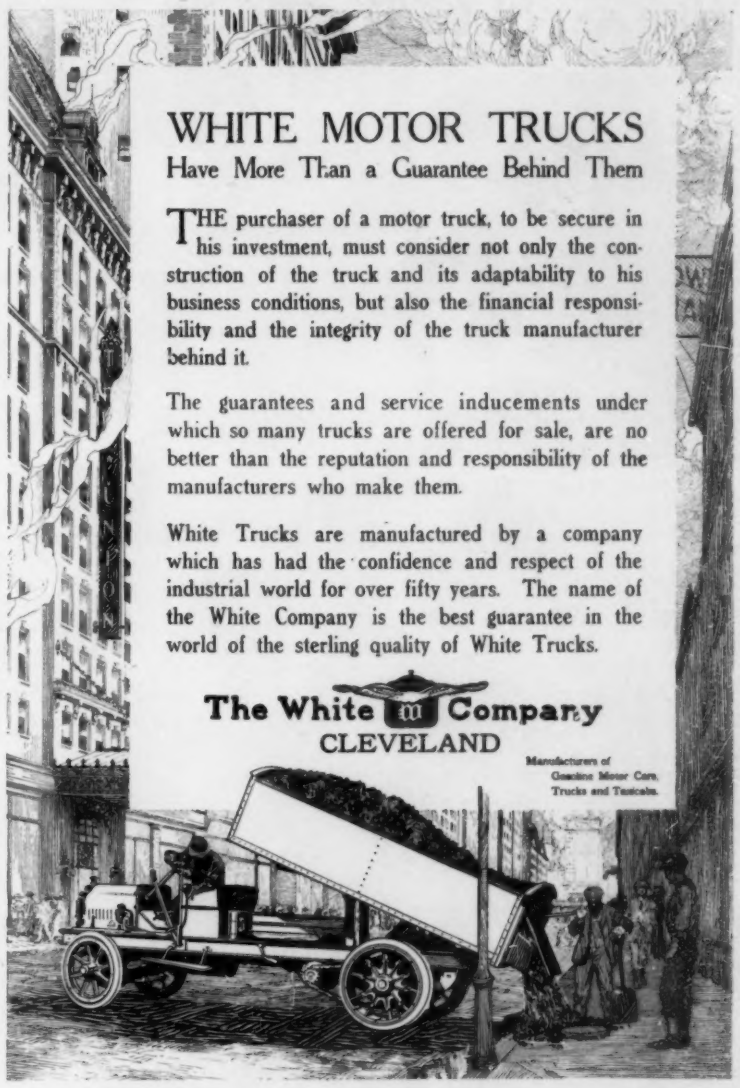
The man who has been the moving spirit in the inarch work of the Government is George W. Oliver, who has charge of the Government hothouses at Washington. Mr. Oliver, like so many of the great gardeners and agriculturists of the nation, is a Scotchman. The greater part of his life has, however, been spent in the United States, and for many years his has been the ceaseless care that has kept the temperatures right in the Government hothouses for growing plants that range from the Arctic circle to the equator. This transfusion of the energy of one plant to another is his final success, but is merely typical of the manner in which he works the things of the vegetable kingdom and succeeds where there would seem hope for nothing short of witchery.

The "Commonwealth"-"New Hampshire" Collision

(Concluded from page 73.)

watch, all were asleep on both ships, the crews repaired quickly and quietly to their stations, and eye-witnesses on board each vessel state that there was no confusion of any kind. The "Commonwealth" backed off, proceeded to her landing, and discharged passengers and cargo. The crew of the battleship at once set about preparations for effecting the necessary temporary repairs to enable the vessel to proceed to the nearest navy yard.

These consisted of two wooden bulkheads securely bolted to the ship's sides and decks and suitably braced to withstand heavy seas from aft if necessary. By working day and night a thoroughly efficient watertight job was completed entirely by the vessel's crew in four working days. Here again theory is borne out by practice, showing that the modern battleship actually is a self-contained and independent unit, capable in an exigency of executing even such extensive repairs as were evidently necessary in this case by means of her own force of mechanics, properly directed by her own efficient officers.



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